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# Essays on the Municipal Bond Market 

By

Sean Mikel Wilkoff

# A dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy 

> in

## Business Administration

in the

Graduate Division
of the
University of California, Berkeley

Committee in charge:
Professor Dwight Jaffee, Chair
Professor Robert Edelstein
Professor Robert Helsley
Professor Daniel Rubinfeld

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# Essays on the Municipal Bond Market 

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Sean Mikel Wilkoff


#### Abstract

Essays on the Municipal Bond Market by Sean Mikel Wilkoff Doctor of Philosophy in Business Administration University of California, Berkeley Professor Dwight Jaffee, Chair

The municipal bond market is a financial market that does not draw much attention from academics, researchers, the government or practitioners. However, that changed recently when the largest recession since the Great Depression impacted the U.S. economy. Now everyone is struggling to understand two major questions: 1) How do we mark to market bonds in illiquid markets? and 2) Why are $50 \%$ of new issues insured in a market that has the lowest default rate of any bond market other than the treasury market? This dissertation examines those questions in three parts.

The first part, The Effect of Insurance on Municipal Bond Yields, studies the difference between insured and uninsured municipal bond yields. I find that although some of that difference is attributable to the effect of insurance, another channel comes from self selection to insure - municipalities that choose to insure differ significantly from municipalities who choose not to insure. Without accounting for the latter self selection the insurance benefit appears undervalued. By focusing on municipalities with both outstanding insured and uninsured bonds (mixed municipalities), I identify that in the pre-crisis period insurance for such municipalities reduces municipal bond yields by 8 basis points. But analysis of homogeneous municipalities reveals the self selection effect raises yields by 6 basis points. However, during the recent financial crisis, insurance continued to lower yields by 8 bps , whereas the self selection effect increased yields by 18 basis points. Thus, my work explains the recent initially puzzling phenomenon when insured yields rose above uninsured yields.

The second part, The Effect of Insurance on Liqudity, examines liquidity in the municipal bond market during the recent financial crisis. I analyze the effects of insurance on liquidity for municipal bonds and estimate how the effects of insurance change when the insurers face a loss of capital and rating downgrades. I measure


liquidity in the three ways most suited for illiquid markets: the Amihud measure, Roll's bid-ask measure, and turnover. By all three measures, both before and after the financial crisis, bonds with insurance are less liquid than bonds without insurance. I also find that the liquidity of bonds with insurance decreases over the financial crisis. These findings indicate that insurance does not improve liquidity.

The third part, A Municipal Bond Market Index Based on a Repeat Sales Methodology, introduces a repeat sales methodology to create an index for the municipal bond market based on transactional prices, because the current indices are based on estimated bond prices. The repeat sales methodology can calculate an index for any municipal bond characteristic. I create and analyze indices for the municipal bond market and separate indices by rating, maturity, and characteristics such as insurance and bond type (i.e. General Obligation or Revenue). Repeat sales methodology is based on the assumption that characteristics of the bond do not change over time which means the movements in bond prices are due to evolving market conditions. I compare the repeat sales indices with the existing municipal bond indices and find the repeat sales indices highly correlated with the current indices with a correlation of . 8 .

To My Grandfather, Marvin David Teplitz,
Who taught me the value of patience.

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I end with a riddle for those in need of a little perspective. What goes on four legs in the morning, on two legs at noon, and on three legs in the evening?

## Chapter 1

## The Effect of Insurance on Municipal Bond Yields

### 1.1 Introduction

U.S. municipalities are in crisis. In November 2011, Jefferson County Alabama, over 4 billion dollars in debt, filed the largest municipal bankruptcy in U.S. history. But municipalities are not the only entities facing bankruptcy; the municipal bond insurance industry is in even greater financial distress. Every time there has been a significant municipal bond crisis, such as the New York debt moratorium of 1975 or the Washington Public Power Supply Station (WPPSS) default, the percentage of the municipal bond market that is insured has increased. In 2005 this figure grew to $50 \%$ of the 2.7 trillion dollar municipal bond market. This time, however, as a result of entry into the structured finance market, the municipal bond insurers have been caught in the crisis. Where there once was an industry with seven AAA rated insurers, now only two insurers remain, one rated AA Assured Guaranty and the other rated $\mathrm{BBB}+\mathrm{MBIA}$.

The downgrades of the municipal bond insurers occurred when insurance was most needed, and this timing made Congress question the benefit of municipal bond insurance, which is intended to provide lower costs of funding to municipalities. The ability of municipalities to issue low cost debt is important to the federal government, which is why there is no federal tax on municipal bonds and why a federal reinsurance program to bail out the municipal bond insurers was considered in 2009. While, typically, insurance is used to reduce default risk, historically, all S\&P rated municipal bonds have a cumulative default rate of $.29 \%$, and investment grade bonds, those
most likely to be insured, have a cumulative default rate of $.20 \%$. Compare this with corporate bonds, which firms cannot insure and have an overall cumulative default rate of $12.98 \%$.

While the government is now taking an interest in the benefit of municipal bond insurance, since the 1970s, when municipal bond insurance started, a debate has been ongoing as to whether or not such insurance provides a net benefit and, if that is in fact the case, where that benefit comes from. The municipal market has over 50,000 issuers of tax-exempt securities, and many frictions beset this market. Such frictions include the following four categories. In the first place, there is asymmetric information caused by the slow rates at which municipalities update and disclose information. The second friction is the existence of separate rating scales for municipal bonds and corporate bonds. This friction would not exist if regulations differentiated between scales instead of treating ratings from each scale as equivalent. Third, while municipal bonds are exempt from both federal and state taxes, the bondholder must be a resident of the state the bond was issued in to benefit from the state exemption. Finally, the majority of bondholders in this market are individual investors who hold $60 \%$ of the market directly as well as indirectly through mutual funds. In the past, yields on insured bonds were below uninsured bond yields; however, recently this trend has reversed, and insured bond yields are now greater than uninsured bond yields, suggesting insurance increases yields on municipal bonds.

Past research attributes the difference in municipal bond yields to insurance. However, this is problematic because the insurance benefit does not account for the underlying differences between those municipalities that purchase insurance and those municipalities that do not purchase insurance. Using a new identification strategy I decompose yields into an insurance component, which is the yield reduction provided by insurance, and a self selection component, which is the yield change attributable to the difference in municipalities who choose to insure. By accounting for municipality effects, I estimate the effect of municipal bond insurance on municipal bond yields and explain what caused yields on insured municipal bonds to rise above yields on uninsured municipal bonds. As expected, the insurance effect always provides a reduction in municipal bond yields, but counter to standard signaling models, the selection into insurance increases yields. I show that insured yields rose above uninsured yields due to a joint effect of a decline in the insurance benefit, caused by declining credit quality of the insurers, and an increase in the selection into insurance effect, caused by concern about the underlying difference between municipalities who purchase insurance and municipalities that do not purchase insurance.

In the data there are two types of municipalities: those municipalities which have both insured and uninsured debt outstanding, which I refer to as mixed municipalities, and those municipalities with only one type of debt outstanding (either all insured or all uninsured), which I refer to as homogenous municipalities. In a new strategy to single out the insurance benefit I focus on mixed municipalities. By regressing the spread between municipal bonds and Treasury bonds on a dummy for insurance and other bond characteristics, I find that insurance provides a yield reduction of eight basis points (bps). Since insurance premiums are on average one and a half basis points a net benefit remains. By using only mixed municipalities I control for the idiosyncratic effects of the municipality and subsequently estimate the benefit of having insurance. On the other hand, estimating the difference between insured yields and uninsured yields for homogenous municipalities gives a value that contains the insurance benefit plus the self selection effect. To obtain the yield change attributable to the self selection effect, I run a difference in difference regression with the spread between municipal bonds and Treasury bonds on the left-hand side and an interaction between a dummy indicating insurance status and a dummy to identify if the municipality is mixed or homogenous on the right hand side, while controlling for bond characteristics. It turns out that self selection increases yields on insured bonds by six basis points. This analysis is consistent with the data during the financial crisis. As insurers are downgraded and go bankrupt, the insurance benefit stays at eight basis points while the effect of selection into insurance rises to 18 basis points.

To control for bond characteristics I focus on long term, noncallable, fixed rate, general obligation (GO), tax exempt bonds with AA underlying rating at the time of the transaction. I focus on GO bonds because GO bonds provide for the full faith and backing of the municipality, where if necessary, municipalities will raise taxes to pay for GO bonds. By contrast, revenue bonds have a claim on the revenue of the project being funded, but have no outside recourse if the project fails. The claim to cash flows will be the same for every outstanding bond, where as revenue bonds will have claims to different cash flows. Therefore I restrict my attention to GO bonds because revenue bonds are claims to different cash flows.

The rest of the paper proceeds as follows. Section 1.2 provides background on the structure and participants of the municipal market. Section 1.3 reviews existing literature on municipal bond markets and discusses how my findings fit in the existing literature. Section 1.4 presents my hypotheses about the effect of insurance on municipal bonds. Section 1.5 reviews the data available. Section 1.6 discusses the methodology for separating insurance effects. Section 1.7 presents and interprets the
results. Section 1.8 concludes.

### 1.2 Background

I review salient features of the municipal bond market and municipal bond insurance that are necessary to understand how I identify the value of insurance. I discuss the role of municipal bond insurers and credit rating agencies in the municipal bond market. I also explain why the bond insurers went bankrupt during the recent crisis.

Bond guarantees differ from other types of insurance in their payout structure and the way issuers pay for the insurance. Namely, a given municipality makes a one-time upfront payment out of the bond proceeds to the insurer who in turn provides insurance for the life of the bond. In case of default, the insurer continues the scheduled interest and principal payments until either the municipality resumes payments or the bond matures. If the municipality is able to resume payments, it is required to compensate the insurer for any missed payments and incurred legal fees.

When municipalities want to sell a bond issue, there are two ways in which they can decide who will underwrite the issue. They can either use a competitive offering where underwriters bid on the issue for sale and the lowest bid wins. In this case, the bid will include any insurance cost so, if the bid with insurance is cheaper than the bid without insurance, the municipal bond will have insurance. Alternatively a negotiated offering is where the municipality directly picks an underwriter to sell the bond issue. Underwriters do not submit bids in the negotiated method, but rather the municipality picks the underwriter that it prefers to work with. In the negotiated offering the underwriter works with the municipality on deciding when to issue the bonds and determining bond yields.

While the standard role of insurance is to protect against the default risk; Hempel (1971), Moody's report, and S\&P report show that the default probability of investment grade municipal bonds is less than $0.01 \%$ going back to the 1950 's. ${ }^{1}$ Most defaults occur in housing and healthcare municipal bonds.

One key benefit that municipal bond insurance provides is an improved rating for the municipal bonds. Municipal bonds can receive a credit rating from three different credit rating agencies (CRAs): S\&P, Moodys and Fitch. The CRA ratings are similar but I use credit ratings provided by S\&P. S\&P issues two types of ratings: a standard rating, which is the rating that encompasses any credit enhancement, and an underlying rating, which is the rating of the municipal bond without insurance.

[^0]Uninsured bonds only have a standard rating. For insured bonds municipalities can choose to have a standard rating or both a standard and underlying rating. ${ }^{2}$ I refer to the rating of the municipality without insurance as the underlying rating. Insurers on the other hand receive their own rating. The standard rating of a bond then refers to the higher of the two ratings, either the rating of the bond or the insurer.

### 1.3 Literature Review

Early empirical research focused on answering if insurance created a net benefit to municipalities. Three papers estimate the net benefit of municipal bond insurance based on a comparison of insured and uninsured municipal bond yields. Two of the three papers measure the net benefit of insurance based on true interest cost (tic), the internal rate of return (IRR) of the bond issue that sets the bond coupon payments equal to the bid price paid by the underwriter. The third paper measures the cost of insurance using net interest cost (nic) defined as the average annual interest cost of a new serial issue. However, the authors comment that tic is preferred and that similar regressions to their paper have been run using tic and do not have differing results. ${ }^{3}$

Braswell, Nosari, and Browning (1982) regress tic on size, maturity, offering type dummy, GO dummy, rating dummies, municipal bond index and an insurance dummy. The coefficient on the insured dummy is their estimate of the yield effect of insurance which they find to be positive but not significant leading to their conclusion that insurance is not value enhancing. Cole and Officer (1981) and Kidwell, Sorensen, and Wachowicz (1987) estimate a regression similar to the previous regression for uninsured bonds without the insured dummy. Then they apply the estimated equation to their insured bond sample and interpret the residual as a measure of the value of insurance. Cole and Officer (1981) do not provide an estimate of the savings but find a significant negative difference between the true interest cost with and without insurance implying insurance provides a net benefit. Kidwell, Sorensen, and Wachowicz (1987) includes insurance premium data and estimates the net benefit of insurance to be from -3.8 basis point for AA rated bonds to 59 basis points for BBB. Kidwell, Sorensen, and Wachowicz (1987) goes a step further by saying the informational asymmetry provides the net benefit of insurance and that the information asymmetry is greater as the credit quality declines. The key point here is that all of these

[^1]paper estimate the insurance benefit without accounting for the underlying difference between municipalities that choose insurance and municipalities that do not choose insurance. In this paper I do not evaluate if insurance is cost effective but I estimate the insurance benefit accounting for the inherent difference in insured and uninsured municipalities.

Another limitation of the previous papers is their ability to analyze only one insurer, MBIA. Quigley and Rubinfeld (1991) have the same data issues as the aforementioned papers, but they take advantage of a time when some bonds issued without insurance were sold on the aftermarket with insurance. This means that bonds issued without insurance were later sold with insurance in the secondary market although not all the bonds of an issue were sold with insurance only a fraction of them. This provides a great natural experiment, comparing insured and uninsured bonds from the same issue, to estimate the benefit of insurance. They limit their sample to bonds without call provisions and find that the effect of insurance is substantial creating a 14 to 28 bps decrease in terms of yields. Quigley and Rubinfeld (1991) estimate the effect of insurance by regressing municipal bond yields on indices for interest rates, dummies to control for the issuer and an insurance dummy. Their strategy is similar to mine in that they match the bonds by issuer to control for confounding factors. However, I take this one step further by controlling for bond characteristics such as callablility, bond type, and maturity while their strategy estimates the value of insurance for a given bond it then averages the benefit over all the issuers and the factors just mentioned could allow insurance to provide a larger benefit. Also because they are looking in the aftermarket for insurance the bonds that investors purchase insurance for are the bonds whose municipality chose not to get insurance separating them from the municipality that needed insurance. While this provides an estimate of the value of insurance to an uninsured type it does not estimate the value of insurance for the type that needs insurance. Assuming the two types do have inherently different qualities these values will be different, this paper estimates the latter value.

A few papers provide theory explaining the benefit of insurance while others provide empirical tests to explain different mechanisms through which insurance provides a benefit.

Thakor (1982) presents one of the first theoretical explanations for debt insurance. Thakor's third party signaling model applies to any market where a third party can gather information to alleviate a lemons problem, but in order to look at equilibrium he focuses on debt insurance. He sets up the standard lemons market with an asymmetric information problem where issuers know their type but the investors do
not. In this model a third party pays a fee dependent on the issuer type to learn the type of the issuer and then uses that information to sell them insurance. The amount of insurance bought by the issuer is increasing in the quality of the issuer and the premium charged is decreasing in the quality of the issuer. He finds a separating equilibrium whereby the highest quality issuers buy the most insurance and in a non-separating equilibrium where all issuers are fully insured and the market interest rate is the risk free rate. The issuers are able to signal their quality through their purchase of insurance. Thakor (1982) makes reference to the fact that the type of insurance he is discussing is popular in the municipal bond industry. In Thakor's model issuers can decide how much insurance to buy. In reality this model does not hold because municipal bond insurance is an all or nothing decision and empirically the highest quality issuers do not buy insurance. However, Thakor's model provides a mechanism whereby issuers might buy insurance for the signaling benefit regardless of any insurance benefit. The results in this paper suggest the market perceives the municipality that gets insurance to be the lower type counter to predictions in Thakor (1982). Thakor's model highlights the fact that there are differences between the municipalities that get insurance and municipalities that do not get insurance. I suggest municipalities are not signaling but purchasing insurance in order to reduce liquidity risk.

Nanda and Singh (2004) model the insurance benefit as a tax arbitrage. In their model the insurer is default free and by purchasing insurance the expected value of the tax exemption is increased because the insurer becomes the issuer of the tax exempt debt. Not everyone purchase insurance because the downside is investors no longer have a tax loss benefit, referred to as a capital loss, as there is no default for insured municipal bonds. The interplay between the increased tax arbitrage and the elimination of the capital loss determine who purchases insurance. Their model suggests that insurance is more likely for municipalities with higher recovery rates and for a given default risk the decision to insure depends on recovery rate. My findings suggest that the market is more concerned about getting their full value on the insured bonds than the uninsured bonds which is contrary to the prediction of Nanda and Singh (2004). However, the model I present is in line with their empirical findings in that a larger bond issue and longer maturity increase the benefit and likelihood of insurance. They also find that insurance for the top ratings is less likely than for the lower rated this is also in accordance with my model which would suggest larger liquidity gains to lower rated municipalities given the clientele effect for holding AAA assets.

Angel (1994) provides an overview of the riddle surrounding the existence of insurance and documents the possibilities over which insurance could provide a benefit. He concludes that insurance provides a benefit by increasing the liquidity of municipal bonds. Angel (1994) discusses this result but does not include a model or empirical work to support his idea. I follow through on his conjecture by examining the difference between the insured and uninsured group and suggesting a model by which insurance is assumed to increase liquidity and provide a net benefit to municipalities who are more illiquid.

In the recent literature on municipal bond insurance, Gore, Sachs, and Trzcinka (2004) provide evidence that insurance is also a tool for providing information. They compare Michigan and Pennsylvania, two states with different laws on bond information disclosure. They find in Pennsylvania, where regulations are less stringent, municipalities tend to augment the limited disclosures with insurance. In states like Michigan with tighter disclosure laws, issuers use less insurance. The key point is Gore, Sachs, and Trzcinka (2004) provide empirical evidence consistent with my findings. When it is more costly to disclose information a municipality purchases insurance but when the market is more certain about a municipality, i.e the municipality is forced to disclose information, the liquidity benefit is reduced and insurance is not purchased.

Downing and Zhang (2004) point out the municipal market is less transparent than the equities or futures markets. Because municipalities are not subject to the same disclosures as publicly traded corporations. While Downing and Zhang use this fact to examine the volume-volatility relationship in the municipal market it is also a motivation for why there might be benefits to insurers gathering information. They highlight an important point for why insurance is not prevalent in the corporate market, the fact, that the market has relatively up to date information about a firm at any given time.

Denison (2003) examines a market segmentation theory as the reason for municipal bond insurance, the effect of an excess demand for low risk bonds and an excess supply of high risk bonds. The theory suggests that the yield differential between Moody's rated Baa and AAA rated will influence the benefit of insurance and therefore the likelihood of getting insured. Denison contributes to the empirical facts on likelihood of insurance and finds the spread between Baa and AAA does not affect the decision to insure, but finds the supply of bonds in the market affects the insurance decision. The larger the outstanding bond supply the more likely the municipality is to get insurance. This finding supports a model where municipalities who have a liquidity
premium associated with them are more likely to get insurance.
In a working paper (Liu 2011), Gao Liu explores the idea that insurers have more information about municipal bond default risk then credit rating agencies. Liu claims the premium charged by insurers to issuers is a more accurate measure of bond quality then the bonds underlying rating. Liu (2011) measures insurers valuation of bond quality by using the insurance premia to predict rating downgrades, a proxy for defaults. A proxy for defaults is needed because of the rarity of default events in the municipal market. Insurance premia provide information beyond what is included in the credit rating for predicting downgrades. Gao attributes the prediction of rating downgrades to insurers using their extra information to fairly price insurance for the riskier issuers. Rating upgrades are not predicted because insurers charge issuers they know to be better quality than their public rating, the average insurance cost for their public rating instead of charging them the actuarially fair price. Liu's findings can be consistent with Thakor's model where instead of issuers choosing how much insurance to buy they are differentiated on the premium they are charged to buy full insurance. The results suggest that insurers are pricing in the actual risk for municipalities that are riskier than the stated rating and insurers charge better rated municipalities the average premium based on their rating but this would not leave any benefit for the low type and would be costly for the higher type.

I suggest a model that would account for the premiums being set correctly according to actual risk but still providing a benefit to the municipality through the unpriced benefit of liquidity. The municipalities that are not properly rated might have a more costly time providing information which is why they went to insurance in the first place. Liu finds uninsured bonds are more likely to experience rating changes but this could be because rating agencies can more easily get information on these municipalities so the ratings remain accurate. Liu does document insurance premium of .91 to 2.10 basis points for AA rated municipal bonds based on their underlying rating from california during 2001-2005. These premiums provide support that insurance provides a net benefit to municipalities because the premiums are less than the 8 bps yield benefit of insurance.

Pirinsky and Wang (2011) look at the effect of tax induced clientele on municipal bond yields. They argue the difference in taxes between states segments the municipal bond market and accounts for many of the municipal bond market puzzles. Due to differences in state taxes insurers ability to diversify across regions allows them to generate a surplus that they can share with the municipalities. Empirical findings distinguish their story from Nanda and Singh (2004) tax arbitrage model. They use
a logit regression to compute the likelihood of insurance controlling for maturity, tax rate, tax status of the state, income per capita, investment per capita, callability, treasury bond yield and new debt issuance. The new debt issuance variable provides the coefficient of interest as it represents the likelihood of getting insurance based on the ratio of municipal bond issuance during the year relative to the population of the municipality. The likelihood of insurance is increasing in debt issuance relative to population which goes towards arguing their story and mine over Nanda and Singh. This paper provides a story in line with Pirinsky and Wang (2011) in that they look at one aspect of liquidity the difference due to differing tax benefits. I provide a story that encompasses risk neutral investors and all aspects that would differentiate the liquidity risk between two issuers even within the same state.

Shenai, Cohen, and Bergstresser (2010a) find that during the crisis yields on insured municipal bonds increase above yields on uninsured bonds with the same underlying rating. Shenai, Cohen, and Bergstresser (2010a) estimate the yield benefit of insurance using the same methodology as previous literature except that they allow for the direction of the trade when looking at yields. Shenai, Cohen, and Bergstresser (2010a) attempts to explain the rise in insured yields over uninsured municipal bond yields by looking at the effect of liquidating tender option bond programs but concludes the rise in insured municipal bond yields was not caused by the TOB programs. Another possibility is the possible effect of mutual funds and insurers selling off insured debt but they find the opposite to be true that mutual funds are tending to hold insured debt. Next they consider liquidity by evaluating a roundtrip transactions cost measure developed by Green, Hollifield, and Schrhoff (2007). The transactions costs for insured bonds is 30 basis points more expensive than for uninsured bonds while prior to the crises the cost is 10 basis points. They explain the 10 basis points as a heterogeneity in investors, my model suggests a different explanation. The uncertainty surrounding the previously insured municipalities is greater and the dealer is more concerned with over paying and therefore charges higher transaction costs. I build on Shenai, Cohen, and Bergstresser (2010a) by explaining the inversion in yields is due to the underlying difference in liquidity between insured and uninsured issuers. The underlying differences exist prior to the crises but are exacerbated during the crisis. As the insurance benefit is reduced and liquidity concerns increase there is a larger positive yield differential between the insured and uninsured municipal bond yields.

This paper takes a new approach to identifying the value of insurance and the information contained in purchasing insurance separately. Similar to Quigley and

Rubinfield I use issuers who have insured and uninsured issues outstanding. I build on the previous literature by estimating an insurance benefit that controls for selection into insurance. The recent financial crisis allows an analysis of the benefit of insurance as the credit quality and credibility of the insurers is removed. I present a simple model that suggests the benefit of insurance comes from insurances ability to improve the liquidity of a bond while not charging the municipality for this benefit due to the competitive nature of the insurance market.

Green, Hollifield, and Schrhoff (2007) and Harris and Piwowar (2006) estimate measures of transaction costs taking advantage of the MSRB data which provides who initiated the trade with the dealer. Both papers find dealer mark up or transaction costs are increasing in insurance which Green, Hollifield, and Schrhoff (2007) includes as a complexity feature but Harris and Piwowar (2006) analyzes directly. There results suggest a downward bias in the impact of the insurance benefit such that if there were no dealer markup the benefit from insurance would be greater. My findings include the dealer markup in calculating the difference between insured and uninsured yields.

### 1.4 Hypotheses

I am going to state the main hypotheses that will be tested in section 1.7. The first question I explore looks at the effect of insurance on municipal bond yields.

Proposition 1. The net benefit of insurance lowers yields on bonds.
Insurance reduces the risk of municipal bond default and improves liquidity but only charges for the credit enhancement so the benefit should outweigh the cost.

The second question I ask estimates the change in the yields of municipal bonds due to a self selection effect. The self selection separates the liquid type from the illiquid type.

Proposition 2. Without insurance the group who would benefit from insurance will have a higher yield.

If there exists unobservable differences between insured and uninsured municipal bonds, then the purchase of insurance will separate the market into two types. I hypothesize that the illiquid type purchase insurance because the insurers charge the rate for the average AA making insurance underpriced for the illiquid type. Therefore since the market can identify the illiquid type the yield on illiquid bonds is higher. The differences between the insured and the uninsured is what the market is pricing.

Proposition 3. A decrease in the insurer's credit quality increases the yield on the insured bonds.

If the insurer's default probability increases, then the likelihood the insurer pays in a default event decreases and the insurance becomes worthless.

Proposition 4. An increase in the likelihood of a liquidity discount raises the insured yield.

The unobservables that make a municipality the illiquid type in normal times will be exacerbated in times of crises causing the market to put a higher premium on illiquid municipalities.

### 1.5 Data

I merge three different data sources to create a testable municipal bond database. The Municipal Securities Rulemaking Board (MSRB) provides transactional data from 2006 to 2009. Standard and Poors (S\&P) provides ratings and bond characteristic data. Additional characteristic data comes from Bloomberg.

The MSRB transactional data contains over 20 million transactions on over 700,00 individual long term municipal bonds. I match the transactions with data from S\&P. The S\&P data contains standard ratings, standard rating changes, S\&P Underlying Rating (SPUR) if available, SPUR changes, and bond characteristics from 1989 to 2009. A SPUR represents the rating of a bond without credit enhancement. If credit enhancement does not exist for the bond, then the SPUR rating will not exist. However, bonds without a SPUR may have credit enhancement. For each transaction I match the bond's most recent rating prior to the transaction date. So each bond has the most up to date underlying rating at the time of the transaction. I supplement each transaction with Bloomberg data including callability, maturity, offering type, coupon, issue size, bond size, and state in order to control for bond characteristics. All data sets are matched by cusip. In the merged data I restrict myself to bonds that are long term, non-callable, general obligation, tax exempt and have a AA (AA-, $\mathrm{AA}, \mathrm{AA}+$ ) underlying rating. Among the insured transactions I focus on those trades that are insured by AMBAC, MBIA, FSA, or Assured. The MSRB data records who initiated the transaction. I use transactions where an investor is buying a municipal bond from a dealer. For this study I treat an underlying rating of AA-, AA and AA+ as an underlying rating of AA.

Merging the four sources yields a data set that covers all daily municipal bond secondary transactions from 2006 to 2009. The 2006 to 2009 period has the advantage of covering the time period before, during, and after the downgrade of the insurers.

There are 762 unique municipalities in the sample, as defined by the first six digits of the cusip. There are 231 mixed issuers whose bonds traded over the 20062009 time period. These bonds comprise 86,232 of the transactions or $64 \%$ of the sample. The number of homogenous municipalities is 531 making up the remaining $36 \%$ or 49,447 transactions. Further summary statistics can be found in Table 4.73 and 4.67. Definitions of all the variables used are in Table 4.16.

Shenai, Cohen, and Bergstresser (2010a) use a sample similar to the one in this paper except they include more years of MSRB data and use Mergent to add characteristics while this paper uses Bloomberg and S\&P.

### 1.6 Methodology

In this section I provide a new identification strategy for separating the value of insurance from the value of self selection. I examine the bias in the past estimates of insurance value and explain a strategy to control for issuer effects in order to create an unbiased estimate of insurance value. The last part of this section documents how the value for selection into insurance is estimated.

### 1.6.1 The Biased Value of Insurance

Shenai, Cohen, and Bergstresser (2010a) document that during and after the collapse of the municipal bond insurers insured yields rose above the uninsured yields for the first time. I confirm this finding by looking at the difference between insured and uninsured yields while controlling for underlying rating and bond characteristics. In the following regression $\beta_{1}$ provides a estimate of the value of insurance

$$
\begin{equation*}
\text { Spread }_{i, j, r, t}=\beta_{1, t} * \text { Insured }_{i}+\underline{\beta_{k, t}} * X_{i, k}+\underline{\beta}_{s, t} * \gamma_{s}+\epsilon_{i, j, r, t} \tag{1.1}
\end{equation*}
$$

where Spread $_{i, j, r, t}$ represents the spread to treasury for municipal bond i, issued by issuer j with rating r in time period $\mathrm{t}, \gamma_{s}$ is a set of state controls, $X_{i, k}$ is a vector of k standard controls used to estimate municipal bond spreads to Treasury for bond i, such as maturity, bond size, issue size, and time outstanding. The full list of control variables used can be found in Table 4.16. The plot of $\beta_{1}$ estimates can be found in Figure 4.1. I also run a second specification to control for census level data about
issuer financial characteristics:

$$
\begin{equation*}
\text { Spread }_{i, j, r, t}=\beta_{1, t} * \text { Insured }+\underline{\beta}_{k, t} * X_{i, k}+\underline{\beta}_{s, t} * \gamma_{s}+\underline{\beta}_{p, t} * \gamma_{p}+\epsilon_{i, j, r, t} \tag{1.2}
\end{equation*}
$$

where Spread $_{i, j, r, t}$ is the difference between treasury yield and yield on municipal bond i , issued by issuer j with rating r in time period $\mathrm{t}, \gamma_{P}$ is a set of census controls, and $\gamma_{S}$ and $X_{i, k}$ are the same as in regression 1.1. The results of this regression do not vary greatly from regression 1.1.

Regression 1.1, without census controls, is common in the past literature for estimating the value of insurance. The problem with regression 1.1 is its estimate $\beta_{1}$ is biased downward due to the lack of control for issuer effects. However, the difficulty in estimating the insurance benefit lies in creating an identification strategy that accounts for the possibility that unobservable characteristics are correlated with who purchases the insurance. $\beta_{O L S}$ in the previous regression is the true $\beta$, which is the true value of insurance, plus the non-zero normalized covariance between being insured and various unobserved characteristics. Namely, $\hat{\beta}_{O L S}=\beta+\frac{\operatorname{cov}\left(\text { Insured }_{j}, \eta_{j}\right)}{\operatorname{var}(\text { Insured })}$. The unobservable issuer characteristic $\eta_{j}$ affects the decision of issuer $j$ to insure. Hence, the biased estimate of insurance contains two components: an insurance effect, which I assume only depends on the bonds rating and the self selection effect, which depends on the municipality and bond rating.

The idea is that municipalities that choose to insure are different from those municipalities that choose not to insure and the insurance decision is exogenous to the rating of the bond.

### 1.6.2 The Unbiased Value of Insurance

I solve the issue of a biased estimate ( $\hat{\beta}_{O L S}$ ) of $\beta$ by focusing on insured and uninsured bonds issued by the same municipality. Separating the insurance benefit from the self selection effect is possible because there are municipalities who have outstanding bonds that are both insured and uninsured. There are at least two reasons why a municipality may have both types of bonds outstanding; one occurs when a municipality needs to issue more debt than the market is willing to absorb, another one happens if the municipality's marketability changes. Suppose California wants to issue more debt than the market wants to buy. However, the market may be willing to buy insured debt instead because of diversification. In that case California can buy insurance on some of it's debt and either raise more debt or pay a lower yield on the original amount of debt. If, over time, a municipality with uninsured
outstanding debt has a change in it's marketability such that insurance is beneficial and needs to issue more debt the new debt will be insured. This paper evaluates the insurance benefit by estimating the difference between insured and uninsured bonds of the same municipality with the same pure rating while controlling for all other observables. To avoid bias, general obligation bonds are used to control for different rights to cash flows or different funding sources. The following regression removes all unobservable issuer characteristics by controlling for issuer fixed effects.

$$
\begin{align*}
\text { Spread }_{i, j, r, t} & =\beta_{1, t} * \text { Insured }_{i}+\underline{\beta}_{\text {Issuer }, t} * \gamma_{\text {Issuer }}+\underline{\beta}_{k, t} * X_{i, k}+\underline{\beta}_{s, t} * \gamma_{s} \\
& +\epsilon_{i, j, j, t, t} \tag{1.3}
\end{align*}
$$

where $\operatorname{Spread}_{i, j, r, t}, \gamma_{s}$, and $X_{i, k}$ are as before and $\gamma_{\text {Issuer }}$ is a fixed effect controlling for the issuer specific effects. In regression $2.1 \beta_{1}$ provides the unbiased estimate of the insurance effect on municipal bond yields.

### 1.6.3 The Value of Self Selection

In this section I estimate the value of the self selection effect. The intuition behind separating out the selection into insurance component comes from the previous regressions. The biased estimate contains the benefit of insurance and the selection into insurance effect. Subtracting the biased estimate of the insurance effect from the unbiased estimate of the insurance effect produces an estimate of the effect of self selection. Regression 2.1 estimates the difference in yields between insured and uninsured bonds holding all else equal. In other words the $\beta_{1}$ coefficient of equation 2.1 is:

$$
\beta_{1}^{3}=\text { InsuranceValue }
$$

$\beta_{1}$ from regression 1.1 is the insurance value plus a selection into insurance value

$$
\beta_{1}^{1}=\text { InsuranceValue }+ \text { SelfSelection }
$$

By subtracting the differences of these estimates I am left with an estimate of the
self selection effect.

$$
\beta_{1}^{1}-\beta_{1}^{3}=\text { SelfSelection }
$$

The following regression captures the above intuition.

$$
\begin{align*}
\text { Spread }_{i, j, r} & =\beta_{1} * \text { Insured }_{i}+\beta_{2} * \text { All }_{i} * \text { Insured }_{i} \\
& +\beta_{3} * \text { All }_{i}+\underline{\beta} * X_{i, k}+\underline{\beta} * X_{i, k} * \text { All }_{i}+\epsilon_{i, j, r} \tag{1.4}
\end{align*}
$$

where $A l l_{i}$ is an indicator variable of whether bond $i$ is issued by a homogeneous municipality, Spread $_{i, j, r, t}$ represents the spread to treasury for municipal bond i, issued by issuer j with rating r in month t ., and $X_{i, k}$ is a vector of k standard controls as before. All the regressions are run for a pure rating of AA. There are not enough uninsured GO bond transactions in order to run meaningful statistical tests for other ratings.

### 1.6.4 Robustness Check

In section 1.6.2 the estimate of insurance benefit was run only on mixed issuers while the self selection effect was estimated using both mixed and homogeneous municipalities. To account for the possible difference between the groups I estimate the impact a mixed municipality has on an uninsured bond compared to the impact of a homogeneous municipality. Specifically, I regress:

$$
\begin{equation*}
\text { Spread }_{i, j, r}=\beta_{1} * A l l_{i}+\underline{\beta} * X_{i, k}+\underline{\beta} * X_{i, k} * A l l_{i}+\epsilon_{i, j, r} \tag{1.5}
\end{equation*}
$$

where variables are the same as above.

### 1.7 Results

I estimate the results monthly and over four different time periods. January 2006 to June 2007 and July 2007 to December 2009, represent the time period before and after the stock prices of the municipal bond insurers dropped. January 2006 to May 2008 and June 2008 to December 2009 represent the time period before and after S\&P downgraded the municipal bond insurers. The time period around the stock market drop is significant if investors are concerned about the riskiness of the insurers. The period covering the downgrade is of concern to municipal bond investors
if the investors are required to hold AAA securities because a downgrade would force them to sell their insured municipal bonds.

I first examine the unbiased estimate of insurance value. Figure 4.2 represents the value of insurance for the average insurer. On average insurance is responsible for an eight basis points (bps) decrease in yields over the 2006-2009 period. Separating the 2006-2009 time period into the four periods described above shows that insurance provides an eight bps drop in yields for all periods. The previous estimates of the benefit of insurance by time period can be seen in table 4.5 . While the results for each time period are statistically significant I also find that the time periods are not significantly different from each other consistent with an eight bps bond yield reduction over the entire time period. Looking at the benefit of insurance on a monthly basis provides a more detailed explanation of how the insurance benefit changes over time. Insurance reduces yields by approximately eight bps from January 2006 to December 2007. From January 2008 to January 2009 the point estimates of the benefit of insurance are decreasing but the estimates are not significantly different from zero. After January 2009 the insurance benefit is statistically significant and reduces yields by eight bps on average. At no time is insurance responsible for causing insured yields to rise above uninsured yields.

The market did not worry about the claims paying ability of the insurer's when the municipal bond insurer's stock prices dropped, but when the rating of the insurers dropped the market got concerned. A rating downgrade meant the ability and services provided by the insurers were reduced. Investors became worried that losses would not be covered if insurers claimed bankruptcy and the liquidity of insured bonds was changed once the bonds were no longer rated AAA. The value of insurance is composed of many different benefits from monitoring and clientele effects to liquidity enhancement. Unfortunately it is almost impossible to disentangle the different benefits provided by each effect. But the results suggest that insurance reduced yields for insured municipal bonds during the entire period of 2006-2009.

Next I breakdown the insurance benefit by insurer. I expect that those insurers, that remained with a high rating, consistently provide a reduction in yield to insured bonds, while the insurers who were severely downgraded or in bankruptcy provide a smaller reduction in yield or no reduction at all. Figure 4.5 represents the insurance benefit for the insurer FSA which was downgraded from AAA to AA+ and currently remains at AA+. Despite the downgrade FSA provides an increasing yield benefit during the crisis because of high market uncertainty about the municipalities economic condition. As the other insurers are further downgraded, the insurance benefit from

FSA increases from two bps to five bps.
MBIA and AMBAC who were severely downgraded during the crisis, AMBAC filed for chapter 11 bankruptcy in 2010 and MBIA is rated BBB , present a different story of the benefit of insurance. Analyzing figures 4.3 and 4.4 shows that AMBAC and MBIA follow a similar trend but with different magnitudes. Both insurers provide a reduction in bond yields prior to their stock price drop with AMBAC insurance reducing bond yields by 11 bps and MBIA insurance reducing bond yields by two bps. Starting in November 2007 the benefit provided by insurance declines which results in AMBAC not providing an insurance benefit post rating downgrade while MBIA does not provide a benefit beginning in March 2008.

Next I examine the effect of self selection. Figure 4.3 shows the market charged higher yields for insured bonds with an underlying AA rating compared to uninsured bonds. Table 4.9 provides an average estimate of 13 basis points over the entire sample. Either the market thinks that insured bonds are naturally riskier than uninsured bonds, hence the increase in yield associated with being insured, or there exists another difference between insured and uninsured bonds that the market prices. This result supports a liquidity story put forth in this paper over the classic signaling story for which the opposite result is expected.

The self selection effect can be interpreted as the difference in yields between an insured bond and an uninsured bond if the insured bond did not have insurance. Prior to the drop in stock prices of municipal bond insurers the insured municipal bond would trade at six basis points higher than an uninsured bond if the insured bond did not have insurance but after the stock price drop the difference increases to 18 bps . Before the downgrade of the insurers there is a six bps increase in yields between insured and uninsured municipal bonds, whereas after the crisis the difference between bonds is now 20 bps . Characteristics that cause a municipality to purchase insurance are characteristics that cause the municipality to be riskier or less liquid during a crisis.

When looking at the selection into insurance value by insurer the same pattern as in the value of insurance appears. All the insurers have an increasing effect on the yield of insured bonds. However, the value of self selection into FSA insurance stays close to zero in figure 4.9 and during the crises fluctuates around eight bps compared with AMBAC where the value starts off increasing by 12 bps yields and continues to increase yields by 20 bps after the downgrades in figure 4.7 .

Putting the value of insurance and the value of selection into insurance together I find that the cause of the reversal in yields between insured and uninsured municipal
bonds is not due to the insurance benefit but selection into insurance. A comparison of table 4.4 and 4.5 shows that $\beta_{1}^{1}$ is greater than $\beta_{1}^{3}$, the coefficient on the insured dummy for the bias regression is larger than the coefficient on the insured dummy controlling for fixed effects of the issuer. The reversal of yields is not a reflection of insurance but a reflection of the difference in underlying characteristics between insured and uninsured municipal bonds. While that difference increases in times of uncertainty, the difference is always there and it is only with the removal of credit enhancement that the difference can be seen in the yields.

During the time of the data sample AMBAC claimed bankruptcy but the court had not finalized the bankruptcy plan. The result was that even in bankruptcy AMBAC was required to pay out 100 percent on any claims. I interpret the fact that the insurance was still attached to the bond to mean that the main benefit of insurance comes from the insurers ability to upgrade the bond's rating to AAA. If the benefit was due to credit enhancement insurance would provide a benefit even after the insurer's downgrade.

One possibility for the existence of the self selection effect is there are intrinsic difference between municipalities that are mixed versus homogenous. I test for existing differences and find that for uninsured bonds there is no difference in spreads attributable to the type of municipality. This is in agreement with the liquidity model because any bond without insurance does not have liquidity problems so the yields should not be based on the issuer. Also, there are no differences in spreads between insured bonds of homogenous and mixed issuers. The result that bonds of mixed issuers and homogenous issuers are similar shown in tables 4.13 and 4.14 support the finding that the self selection effect is a result of difference between issuers who choose insurance and those that do not purchase insurance.

Using the S\&P data available from 1989-2009 I look at the likelihood of insurance for certain bond characteristics including census data related to the condition of the issuing municipality. The results are similar to the literature in that general obligation bonds, and higher rated bonds are less likely to get insurance while larger and longer maturity bonds are more likely to get insurance. The new census data suggests that such measures of financial strength as debt outstanding, debt issued, interest on debt, wages and property tax on a per capita basis do not affect the decision to insure.

The data shows that as expected insurance provides a positive benefit through the crisis. But the selection value increases yields so the insured group has a higher yield without insurance than the uninsured group. The standard signaling model of Thakor (1982) suggests the high credit quality types would purchase insurance to signal their
quality, but the data shows the municipalities that choose to buy insurance would have had higher yields if they did not buy insurance than uninsured bonds, counter to the signaling predictions.

My liquidity story is in line with the current literature and empirical findings in Nanda and Singh (2004). In the latter empirical work the authors find that the likelihood of insurance is increasing in maturity, log of market value and decreasing in high bond ratings. They find that lower rated and unrated bonds are less likely to be insured due to the fact that the costs to insurers are the largest for unrated municipalities and therefore insurers do not usually offer insurance to unrated or below investment grade rated municipalities. The findings in this paper agree with the results in Nanda and Singh as the longer the maturity of the bond the more investors are concerned with liquidity, hence a larger liquidity benefit accrues to longer maturity bonds. The higher likelihood of insurance for larger market value issues is explained by the fact that as the market becomes saturated with bonds from one issuer, it becomes harder to sell and find investors for these bonds, so such municipalities have a larger liquidity premium, hence the value of insurance goes up. Pirinsky and Wang (2011) find that the higher the debt issuance during a year relative to population, the more likely a municipality is to get insurance which coincides with the liquidity story. This is also consistent with Gore, Sachs, and Trzcinka (2004) who discover that given the choice between information disclosure and insurance municipalities choose insurance because disclosure is costly for firms with larger disclosure costs. Insurance will be a benefit to the municipalities with higher marketability costs. I find that competitively offered bonds are more likely to get insurance which agrees with the liquidity story because competitive offerings happen faster where as negotiated offerings give the underwriter time to market the issue making the liquidity premium negligible.

This liquidity interpretation complements Shenai, Cohen, and Bergstresser (2010a) by explaining the yield reversal they document. The separation of benefits is able to explain why an insured bond yield can rise above an uninsured bond yield because even though the underlying credit quality was controlled for, not all the underlying differences were accounted for such as the difference in natural liquidity of the two groups. This model would also explain why mutual funds and investment companies who are not forced to liquidate like the tender option bond programs would hold on to the insured bonds because they are concerned about the price impact of selling an insured bond, that is the liquidity premium associated with these bonds has increased.

Shenai, Cohen, and Bergstresser (2010a) finds that insured bond underlying ratings are upgraded more than uninsured bond ratings. I do not think this result is
surprising given the control and covenants put on insured issuers by insurers. I would argue uninsured bonds are not worse quality than insured bonds but uninsured bonds are accurately rated and insured bonds have a tougher time communicating information to the market. Which is why their original ratings are lower than deserved. Since the insurer knows the bonds they are insuring are better than the market thinks this is reflected in premium prices. The pricing of the true risk of municipalities is noted in a paper by Liu (2011) that finds the insurers charge the municipality they know to be better quality the cost for their public rating, while they charge the municipalities known to be lower quality higher premiums in line with their lower quality. So municipalities are not getting a benefit based off their credit rating but these municipalities that cannot convey their true quality to the market most likely have informational asymmetries or marketability issues that will allow insurance to provide a benefit to the municipality.

Given the estimates for the benefit of insurance at such small magnitude of eight bps the question arises if insurance would provide a benefit after accounting for insurance cost. This paper addresses this concern with an estimate from Liu (2011) who find the AA insurance premium is between .91 and 2.10 basis points on average per dollar. Which leaves a benefit to issuers of 5.9 to 6.1 basis points.

### 1.8 Conclusion

The main contribution in this paper is separating the pure insurance benefit provided by insurance from the self selection effect and providing empirical estimates of these two components. On average insurance reduces yields by eight basis points and selection into insurance increases yields by six basis points prior to the crisis. During and after the crisis insurance reduces yields by eight basis points but selection into insurance increases yields by 18 bps causing the reversal found in Shenai, Cohen, and Bergstresser (2010a). I also contribute an alternative explanation of why municipalities decide to purchase insurance.

Municipalities rely on the capital markets to keep their cities afloat. During the crisis municipal bond insurers were defaulting before the municipalities they were insuring this made congress question the purpose of municipal bond insurance. Congress wants to help municipalities receive cheap financing which is why they make municipal bonds tax exempt. They want to know if insurance provides a benefit or if the benefit being provided can be reproduced by a cheaper method. For example if the benefit of insurance has to do with the different rating scales used by Moody's then
congress will try to change the way ratings are assigned. It is important for congress to know how insurers provide a benefit. This way Congress can provide cheap and efficient access to the capital markets for municipalities. Eliminating credit ratings as capital requirements and increasing information disclosure or making information disclosure cheaper would likely reduce the use of municipal bond insurance.

Regulators should take into account where the insurance benefit is coming from in molding regulations. There is a lot of change coming in the municipal market from the implementation of Basel III to the shift in Moody's ratings to a global scale.

## Chapter 2

## The Effect of Insurance on Liquidity

### 2.1 Introduction

The recent financial crisis saw the collapse of many investment banks and insurance companies. Trading decreased and spreads widened in most debt and derivative markets. The financial collapse was in large part due to the defaults in the subprime market, the mispricing of counterparty risk and the misreading of the true correlation between assets by the credit rating agencies. All of these problems led to fire sales of assets in some markets and the shutdown of other markets.

Trading below market value and lack of trading are effectively liquidity problems. Liquidity is a highly debated concept, with many different definitions floating around. While liquidity itself has many interpretations, there is a general consensus about which markets are liquid and which markets are illiquid. Even during the best of times the municipal bond market is considered illiquid.

The municipal bond market was affected by the financial crisis both directly through reduced tax revenues and indirectly through the collapse of the municipal bond insurance companies. Municipal bond insurance companies, also known as monoline guarantors, are intended to insure only municipal bonds. However, prior to the financial crisis monolines also sold Credit Default Swaps (CDS) and insurance on Mortgage-Backed Securities (MBS). Because the monolines provided CDS too cheaply and had large capital losses, their credit quality and purpose in general are in question. The uncertainty about the monolines' viability was so great that, at the prodding of the New York insurance regulator, Warren Buffet created Berkshire

Hathaway Insurance to reinsure municipal debt.
With one remaining AA rated insurer (Assured Guaranty), one BBB+ insurer (Municipal Bond Insurance Assurance (MBIA)) and the remaining five bankrupt, the question arises what is the role of insurance? Wilkoff (2012) empirically examines the reduction in municipal bond yields attributed to municipal bond insurance and suggests that one mechanism through which insurance helps reduce municipal bond yields is by improving the liquidity of the underlying municipal bond.

The current paper adds to the empirical literature on measuring liquidity in illiquid markets. It empirically examines the mechanism through which insurance affects liquidity. I test the difference in liquidity between insured and uninsured bonds and extend the analysis to include the impact of the rating downgrades of the municipal bond insurers on municipal bond liquidity. This paper is not the first to examine benefits of municipal bond insurance, but is the first to test the liquidity difference between insured and uninsured bonds both before and after the financial crisis in a systematic manner.

I test for the presence of liquidity using three measures common to the corporate bond market, namely the Amihud measure, Roll's bid-ask spread, and turnover. I regress each measure on an insured dummy while controlling for bond characteristics. This allows me to compare the liquidity of an insured bond to the liquidity of an uninsured bond over a given time period. This paper examines not only the liquidity of insured bonds relative to uninsured bonds, but how the crisis affects the liquidity of insured bonds. I run a difference-in-difference regression to see how insurance's effect on liquidity changes over the crisis period, while controlling for the overall change in the the municipal bond market liquidity at the same time.

I find that the liquidity of insured bonds is lower relative to uninsured bonds which suggests that the reduction in municipal bond yields due to insurance is not due to a liquidity benefit as discussed in Wilkoff (2012). Upon comparing the liquidity of insured bonds before the crisis to their liquidity after the crisis, the results indicate that liquidity decreases after the crisis. In fact it is the downgrade of the insurers themselves that prompts municipal bond liquidity to decrease. This implies that the insurers' ability to increase bond ratings to AAA is how they were providing liquidity assistance. I look at the effect of insurance, holding constant the municipal bond rating, and find uninsured bonds are more liquid than insured bonds for every rating. During the 2006-2009 time period the results indicate AAA bonds were less liquid than non-AAA bonds, as measured by the three methods described above.

The effect of insurance on liquidity can be applied to markets with similar charac-
teristics such as private mortgage insurance (PMI) and MBS. Note that PMI serves individual issuers of mortgage debt, whereas the MBS market has insurance in the form of securitization, which employs over-collateralization and different tranche structures to improve the credit of certain tranches. By contrast, issuer-provided insurance is not common in other debt markets such as the corporate debt market.

The paper is organized as follows; Section 2.1 provides an introduction. Section 2.2 examines background into the players and structure of the municipal bond market, while section 2.3 reviews the current literature addressing debt insurance and liquidity measures. Section 2.4 presents the data available. Section 2.5 develops an argument for insurance providing liquidity as well as my main hypotheses. Section 2.6 discusses methodology for testing the hypotheses. Section 2.7 summarizes the results. Finally, section 2.8 concludes.

### 2.2 Background

In this section, I discuss the role of municipal bond insurers and credit rating agencies in the municipal bond market. In addition, I examine the role of regulations that allow insurance to affect liquidity, as well as relevant features of the municipal bond market that make it illiquid compared to other markets.

Municipal bond insurance works differently from insurance in other markets. In the municipal bond market the municipality makes a one-time upfront payment out of the bond proceeds to the insurer, who then provides insurance for the life of the bond. If the municipality defaults, the insurer steps in and makes the scheduled interest and principal payments, either until the municipality can resume payments, or until the bond expires. In the cases where the municipality is able to resume payment, the municipality is required to pay back to the insurer any missed payments and legal fees required for getting those payments back.

Municipal bonds, like other bonds, typically receive credit ratings from Standard and Poor's (S\&P), Moody's, and accordingly, from Fitch who is the third largest municipal bond rater. S\&P and Moody's have been rating municipal bonds for over 100 years. S\&P was the first of the credit rating agencies (CRA) to rate municipal bonds with the higher rating, of the insurer or the municipality, for insured municipal bonds. Not long after, Moody's also switched from having two ratings for the municipal bond, one for the municipal bond and one for the insurer, to the higher of the two ratings.

In the past Moody's had different rating systems for corporate bonds and munic-
ipal bonds. Moody's has put out transition tables that show that an A-rated general obligation $(\mathrm{GO})^{1}$ municipal bond is equivalent to a AAA-rated corporate bond. The two different rating scales create a disconnect between insurers rated on the corporate scale and the municipalities who are rated on the municipal scale. This allows municipal bond insurers to provide a AAA rating to municipalities for the price of insurance, potentially helping the municipal bond liquidity. Certain types of investors, such as money market mutual funds or insurance companies that hold municipal bonds, are more likely to buy AAA-rated municipal bonds. Such investors are either regulated as some money market mutual funds through SEC (Securities and Exchange Commission) rule 2a7, or they have capital requirements, like insurance companies, to hold assets of high quality. If an issuer can purchase a AAA rating, then a larger pool of investors is available to purchase the issuer's bonds, hence increasing the bonds liquidity.

Moody's is currently shifting all ratings over to a global scale for easier comparison. S\&P claims to have always rated all bonds together on the same scale. It cites the differing ratings distribution for corporate bonds and municipal bonds as proof of using the same scale. Almost $90 \%$ of municipal bonds are rated A or better, compared to corporate bonds where less than $25 \%$ are rated A or better.

Another characteristic of the municipal bond market that contributes to it's illiquidity is tax-exemption. Municipal bonds are exempt from federal taxes and state taxes if you are a resident of the state in which you bought the municipal bond. Because of the tax exemption, investors in the highest tax bracket will benefit the most from holding municipal bonds. Typically investors of municipal bonds are in the highest tax bracket and are looking for a safe investment. Because of the tax exemption in the municipal bond market, the majority of investors are individuals. As the Federal Reserve's Flow of Funds report shows, over $60 \%$ of municipal bonds are held directly or indirectly (through mutual funds) by individuals. Insurance companies also hold a large percent of the municipal bond market, as do pension funds. Banks, who used to hold $30 \%$, now hold closer to $7 \%$ due to the 1986 tax changes, which made it more costly to hold municipal bonds. The composition of investors exacerbates the illiquidity issue because an individual investor in this market holds onto municipal bonds, leading to fewer trades than in other markets. This is evident in my sample, in which the average bond trades nine times per year. By contrast, the average stock certainly trades more than nine times per year.

There are over 50,000 municipalities in the United States, and each municipality is

[^2]a potential issuer of municipal bonds. A large volume of issuers makes it difficult for investors to take the time to learn about all the different issuers. This increases search costs, leading to a less liquid market. Another issue contributing to the illiquidity in the municipal bond market is the availability of information. Because municipalities are not regulated as closely as firms reporting information, information on a municipal issuer can be over a year old and difficult to obtain for an investor.

### 2.3 Literature Review

In spite of the sparse literature on liquidity estimation in the municipal bond market, a literature exists on theories which explain the benefits of municipal bond insurance. Many theories suggest insurance makes municipal bonds more attractive which may directly or indirectly affect liquidity. The channels through which debt insurance can affect liquidity, include signaling, information disclosure, tax-based rationale, and clientele effects.

### 2.3.1 Signaling

Thakor (1982) presents one of the first theoretical explanations for debt insurance. His third party signaling model applies to any market in which third parties can gather information to alleviate a lemons problem. However, in order to look at equilibrium he focuses on debt insurance, using the standard lemons market with asymmetric information where issuers know their type but the investors do not. In the model, a third party pays a fee to learn the type of the issuer and then uses that information to sell them insurance. The amount of insurance bought by the issuer is increasing in the quality of the issuer and the premium charged is decreasing in the quality of the issuer. He finds a separating equilibrium whereby the highest quality issuers buy the most insurance, and a non-separating equilibrium in which all issuers are fully insured and the market interest rate is the risk free rate. The issuers signal their quality through the purchase of insurance.

Thakor makes reference to the fact that the type of insurance he is discussing is popular in the municipal bond industry. His model rests on the assumption that issuers can decide how much insurance to buy. However, in reality municipal bond insurance is an all or nothing decision and the highest quality issuers do not buy insurance. Nonetheless, Thakor's model provides a mechanism whereby issuers might buy insurance for the signaling benefit regardless of any insurance benefit. There are
many institutional investors in the municipal bond market who must hold a certain quality asset. Thakor's model suggests that issuers who purchase insurance should be more liquid than they would be otherwise because the issuers will have a larger investor pool than without insurance.

### 2.3.2 Information Disclosure

In the recent literature on municipal bond insurance, Gore, Sachs, and Trzcinka (2004) find evidence that insurance is also a tool for providing information. They compare Michigan with Pennsylvania and find in Pennsylvania, where regulations are less stringent, municipalities tend to augment limited disclosure with insurance. In contrast, Michigan issuers, with tighter disclosure laws, use less insurance. Downing and Zhang (2004) point out the municipal market is less transparent than the equities or futures markets, since municipalities are not subject to the same disclosures as publicly traded corporations. While they examine the volume-volatility relationship in the municipal market, less transparency may also motivate insurers to gather information.

Recent findings reveal that a number of states have large unfunded pension liabilities due to different accounting methods. Novy-Marx and Rauh (2011) provide evidence that these unfunded pension liabilities increase the cost of borrowing for states. Prior to the new accounting method by which states will have to document these liabilities, the size of these liabilities has been unclear, leaving investors uncertain about the quality of the issuer. One reason investors like municipal bonds with insurance is that insurers are able to use their expertise and have an understanding of where the liabilities exist. Along the same lines, Poterba and Rueben (1999) discuss the difference in fiscal constraints between states. Information that may be hard for investors to examine would allow for economies of scale and leave a benefit to insurers. By mitigating some of these information asymmetries, insurance is able to reduce search costs. Without insurance the underwriter might have to perform more in-depth analysis of the issuer in order to find willing investors. If insurance reduces search costs, then I should find that insurance improves liquidity since lower search costs translate into larger demand or less distortive prices.

### 2.3.3 Clientele Effects

Denison (2001) examines a market segmentation theory as the reason for municipal bond insurance. He examines the effect of an excess demand for low risk bonds
and an excess supply of high risk bonds. This paper stands out from the previous papers by including a theoretical model to motivate the empirical tests and the first, to my knowledge, to include a market wide measure of liquidity in the examination of the municipal bond insurance decision. The data set used is significantly larger and more modern than previous papers.

In the Merton (1987) model investors can only invest in assets they know about. One can think of a AAA rating as giving investors the sense that they know about the municipal bond. Thus, a municipality with an intrinsic rating of less than AAA may gain more from insurance than the improvement in the rating created by insurance. The clientele effect implies that liquidity on insured bonds should be greater while the insurer is solvent. If insurance is removed, then liquidity measures should detect a decrease in liquidity. I test for a change in liquidity once insurers are downgraded.

### 2.3.4 Tax-based rationale

Nanda and Singh (2004) model a tax-based benefit of insurance. They argue that insurance provides a tax arbitrage effect and a capital loss effect. The tax arbitrage improves the desirability of the insurance, where the capital loss effect decreases the desirability. They claim their data supports two predictions; longer maturity bonds benefit more from insurance and the insurance benefit is non-monotonic in underlying credit ratings.

Building on the idea that insurers are able to provide a benefit through diversification, Pirinsky and Wang (2011) attribute insurance benefits to the asymmetric treatment of tax exemption between states. For instance, investors can purchase out of state bonds to achieve a diversification benefit. The benefit comes at the cost of their state tax, although insurance companies can efficiently diversify across geographic regions. Pirinisky and Wang empirically show that the likelihood of insurance increases with the local supply of municipal bonds in the market and the size of the bond offering. Their empirical findings suggest insurance improves liquidity and provides a reason to purchase insurance when the local supply of municipal bonds is large.

The possibility of insurance providing a interest cost savings through improving the liquidity of a municipal bond has been mentioned in this literature but has yet to be investigated. The remaining part of the literature review considers liquidity in a more systematic framework.

Liquidity is a broad concept that is not always clearly defined. For the purposes of this paper the definition of liquidity will be the one adopted by Neis (2006), Liquidity
refers to the ability to transact quickly and easily in a security without substantially affecting prices.

Neis (2006) documents the liquidity premium associated with holding a municipal bond instead of a treasury bond. The liquidity premium is the excess yield required by an investor to hold a municipal bond instead of a comparable treasury bond.

There are few papers that have attempted to empirically capture the liquidity difference due to municipal bond insurance. In recent work, Shenai, Cohen, and Bergstresser (2010a) look at municipal bond liquidity, They document (pre-crisis) bonds with insurance trade more frequently than bonds without insurance. But after the municipal bond insurers are downgraded, bonds with insurance trade less frequently than bonds without insurance. I improve on their analysis by taking a more in-depth look into the effect of insurance on liquidity during the financial crisis. Both Shenai, Cohen, and Bergstresser (2010a) and my work here focus on the fixedrate long-term municipal bond market.

Alternatively, another type of municipal debt is variable rate municipal debt, which is issued by municipalities, short term, and has a variable interest rate that depends on the demand for the bonds. Because of the short term nature of this market, issuers tend to get agreements from banks, or liquidity providers, such that if the issuer is going to miss a payment the bank or liquidity provider will loan them the money to make the payment.

Martell and Kravchuk (2010) look at the effect of liquidity risk in the context of the variable rate municipal debt market. Using a sample of 59 bonds, they focus on liquidity providers instead of insurers and find that the credit rating of the liquidity provider has a larger impact on the reoffering rate than the credit rating of the underlying bond. These previous papers are the only papers that look at the liquidity effect of insurance during the crisis.

One of the main hurdles in liquidity research is identification. Because the municipal market is extremely complex with over 1.1 million securities trading less than nine times per year on average, standard liquidity measures do not always work. The liquidity measures common to other markets such as the corporate bond markets and the equity markets are: bid-ask spreads, zero returns, LOT measure, aggregate liquidity factor, trades per bond, Amihud measure and negative covariance of price changes. I discuss these measures below and explain why I am able to use turnover, bid-ask spread, and the Amihud measure. The remaining measures require more transactions than what is provided by the municipal bond market.

### 2.3.5 Negative Covariance of Price Changes

Bao, Pan, and Wang (2011) build on work by Huang and Wang (2009) and Vayanos and Wang (2007) by using the negative of the covariance in price changes to measure liquidity. They find that liquidity is priced in corporate bonds. Intuitively, the negative of the covariance in price changes suggests that the more illiquid an asset the larger the reversal in prices. In simple cases this would be the equivalent of the bid-ask bounce, but more generally contains more information than the bid-ask spread. Bao, Pan, and Wang demonstrate this fact by calculating the implied value generated from the bid-ask spread and regressing both factors on the bond yield. They illicit information beyond that of the bid-ask spread explained by the negative of the covariance in price changes. Because Bao, Pan and Wang are using changes in prices, they require that a bond trade 75 percent of the days in the observed time period to be used in measuring liquidity. This presents a problem with municipal bonds, because there are zero bonds trade over $75 \%$ of the days during 2006-2009.

### 2.3.6 Number of Trades

Shenai, Cohen, and Bergstresser (2010a) use the trades per bond to measure liquidity. They document (pre-crisis) bonds with insurance trade more frequently than bonds without insurance. But after the municipal bond insurers are downgraded, bonds with insurance trade less frequently than bonds without insurance. Their liquidity measure is the average number of trades per bond for the bond type (whether insured or uninsured). They find that in December 2007 bonds without insurance have approximately 4.3 trades per bond while bonds with insurance have six trades per bond. By the end of 2009 bonds without insurance are more liquid, with five trades per bond, than bonds with insurance, 4.7 trades per bond. Given the nature of the liquidity measure, it can be easily applied to the municipal market. However, by looking at number of trades one may overlook different aspects of liquidity. This measure fails to account for investors that might want to hold their bonds until maturity unless they have a liquidity crunch, in which case they want to sell their bonds with the least price impact. In this case it is not clear that the number of trades matter, rather than the impact a trade itself has on the market. This current paper uses turnover to measure liquidity instead of number of trades, since turnover adjusts for the amount of debt outstanding.

### 2.3.7 Aggregate Liquidity Factor

Pastor and Stambaugh (2003) develop a liquidity measure for the stock market. They regress a stock's excess return on a constant, the stock's return, and the sign of the stock's excess return interacted with the dollar volume for the stock. They then aggregate these measures by taking an average and find that their liquidity factor is significant for asset pricing. In order to apply this to the municipal market one would need to allow for the fact that trades are infrequent, and therefore returns will be over longer time frames. Wang, Wu, and Zhang (2008) apply the Pastor and Stambaugh method to the municipal market. They calculate the liquidity measure for bonds with over 10 observations in the given month. They then aggregate only the measures for the bonds used in their sample. Given the data, the bonds they are choosing will vary from month to month. They find that their liquidity measure is an important part in calculating the yield on municipal bonds and that the sensitivity of their measure to yields is decreasing as ratings increase. As the name implies the aggregate liquidity factor is an aggregate measure of the liquidity in the market. This is not well suited to applying a liquidity measure to individual bonds as I do in my current work, therefore this paper does not use the aggregate liquidity factor.

### 2.3.8 Transaction Based Liquidity Measure

## Lot Measure and Zero Returns

Lesmond, Ogden, and Trzcinka (1999) (LOT) create a measure for liquidity based on zero returns. A zero return is when the price of a security does not change over a given time period. They look at the proportion of zero return days over a year and compare this measure to other proxies for liquidity such as, firm size and transaction costs. They find zero returns are inversely related to firm size and act as a proxy for transaction costs. The intuition behind zero returns is if no trade happens it must be that the benefit of trading for the marginal investor does not outweigh the cost of trading. The lower the costs of trading, which include bid-ask spread, commissions, expected price impact and opportunity costs the more liquid the asset. The measure was created specifically for situations where there is not the necessary information available for calculating the bid-ask spread such as, the corporate and municipal bond markets.

Chen, Lesmond, and Wei (2007) apply the LOT measure to the corporate bond market and find that the liquidity component of the yield spread is not directly related to default risk. Also by comparing the Lot measure with the bid-ask spread they come
to the conclusion that the measure can be used in liquidity studies where information is sparse.

Bekaert, Harvey, and Lundblad (2007) use the proportion of zero returns to proxy for illiquidity in emerging markets where data is sparse. They also create a price pressure measure, which tries to account for consecutive non-trading days, where more days in a row of non-trading may signify a more illiquid bond. They take the sum of the weighted returns of an index, including only stocks with zero returns, where the weights used are the capitalization weights of the stocks and the returns are the returns if the stocks had traded. They divide this sum by the sum of the weighted returns of all stocks in the index. They find this measure is highly correlated with the zero returns measure and therefore a good proxy for liquidity. This measure poses another possibility of measuring the liquidity effect of insurance in the municipal bond market. However, because the municipal bond market is an over the counter market the only available data is for transactions that occur. I am unable to calculate zero return days as I do not know if the value changed or if there was simply no trade. This is why I am unable to use the two previous measures.

## Bid-Ask Spread

One of the most common measures of liquidity is the bid-ask spread. The smaller the spread the lower the price impact from selling a security and therefore the more liquid the security. Longstaff, Mithal, and Neis (2005) are able to separate out the default and non-default component of corporate bonds using cds prices. By regressing the non-default component on measures of liquidity such as the bid-ask spread and principal amount outstanding. They conclude that the non-default component is strongly related to these liquidity measures.

Harris and Piwowar (2006) and Green, Hollifield, and Schrhoff (2007) examine liquidity as measured through transaction costs in the municipal bond market. Harris and Piwowar (2006) estimate secondary trading costs and analyze the factors that affect those costs. They improve upon the earlier literature by taking advantage of the MSRB data set, that I use, to incorporate information from every transaction. They improve upon the literature through better data that includes timing of the trade, size of the trade, and the type of trade (i.e. buy or sell). However, their main focus is not on how insurance impacts liquidity. They do consider insurance by including it as a complexity feature of the bond and looking at how transaction costs change with the complexity of a bond but they do not control for the underlying bond rating.

Harris and Piwowar regress the bond return minus any coupon owed on a short
term index, a long term index, a term that accounts for what type of transaction it was (i.e. buy or sell), and two terms that account for the size of the transaction. They use the coefficients on the size variables and type of transaction to then estimate trading costs. Their result that bond trading costs decrease with credit quality but increases in bond complexity leaves open the question of whether the decrease in trading costs from improved credit quality provided by insurance is enough to offset the increase in trading costs from the increased complexity. Another important finding of the paper is that actively traded bonds are not cheaper to trade than infrequently traded bonds, which emphasizes the importance of how one measures liquidity.

Green, Hollifield, and Schrhoff (2007) is similar to Harris and Piwowar (2006) because they measure transaction costs, but Green, Hollifield, and Schrhoff (2007) use a different estimation approach. While Harris and Piwowar (2006) use a time series estimation approach, Green, Hollifield, and Schrhoff (2007) use a structural model to breakdown the cost of transactions into two parts: the dealer's market power and the dealer's cost. This different approach leads them to similar results as Harris and Piwowar.

### 2.4 Data

I merge three different data sources to create a comprehensive municipal bond database. Municipal Securities Rulemaking Board (MSRB) provides the transactional data for the four year period covering 2006-2009. S\&P provides the ratings and bond characteristic data, while Bloomberg provides additional bond characteristic data. I describe the previous data sources and my methods for merging the data below.

The MSRB transactional data contains over 20 million transactions on over 700,000 individual long-term municipal bonds. Using the cusip of each bond, I match the transaction data with data from S\&P. The S\&P data contains standard ratings, standard rating changes, S\&P Underlying Ratings (SPUR), if available, SPUR changes, and bond characteristics from 1989 to 2009. A SPUR represents the rating of a bond without credit enhancement. If credit enhancement does not exist for the bond, then the SPUR rating will not exist. However, bonds without a SPUR may have credit enhancement. I identify the bond's most recent rating prior to the transaction date. So each bond has the most up-to-date underlying rating at the time of the transaction. I supplement each transaction with Bloomberg data including callability, maturity, offering type, coupon, issue size, bond size, and state in order to control for bond characteristics. All data sets are matched by cusip.

In the merged data I restrict myself to transactions with information on rating and insurance status. I remove transactions that have a negative or zero yield, as they are an error in the data. I am left with over 13 million transactions.

Merging the three sources yields a data set that covers all daily municipal bond secondary transactions from 2006 to 2009. Definitions of all the variables used in the regressions are shown in Table 4.16. I provide summary statistics for the subset of bonds used in each measure. Table 4.17 shows the descriptive statistics for the Amihud measure, where each Amihud value is counted as an observation and Table 4.20 is where each cusip that trades is counted only once as an observation.

The difference between the descriptive statistics implies that longer maturity bonds trade more frequently, the average maturity of a trade is 15.4 while the average maturity for a bond that is part of sample is 11.2 . The average municipal bond in the Amihud sample has a maturity of 15.4 years and a coupon of 4.45 percent. I also break down the trades by rating and consider the pure rating (the rating of the municipality) and the actual rating (the higher rating between the issuer and the insurer) distributions over different time periods. The patterns in the summary statistics are similar across data subsets for the different measures. The pure ratings distribution shows that the same percentage of bond trades are AAA throughout the entire time frame, while AA-rated bonds increase as a fraction of trades. This is clear when one looks at the actual rating distribution, which shows a large drop in percentage of AAA transactions after the insurers start to fail. Another interesting statistic is the percent of insured transactions over the sample, which decreases after the insurers' stock price drops. In some cases $70 \%$ of transactions were insured, but after the crisis only $45 \%$ of transactions were insured. Tables 4.17-4.28 describe the different subsets of data, however, the trends are similar throughout the summary statistics.

### 2.5 Hypothesis

The impact of the recent financial crisis on the municipal bond insurers provides an appropriate environment for empirically testing some outstanding hypotheses. Manconi, Massa, and Yasuda (2010) suggest that bonds previously commoditized through extra protection become less liquid once the extra protection is removed. The intuition is that investors do not have the proper information on the underlying quality of the bond that was protected. When the protection, or, in the case of the municipal bond market, the insurance, is no longer valuable, any investor trying to sell an
insured bond will not get its true value and, will be less likely to sell. As a result the bonds will be less liquid. This is the similar to what happened in the municipal market, so my initial hypothesis is:

Hypothesis 1. A decrease in the insurer's credit quality decreases the liquidity on bonds with insurance.

The prior intuition also means that, if investors need to sell assets, as they did during the crisis, and they cannot sell bonds with insurance at a fair price, then they are more likely to sell uninsured bonds. This is because the information on uninsured bonds is up-to-date, and such bonds can be sold for a fair price. This leads to the following hypothesis:

Hypothesis 2. Bonds without insurance will be less liquid prior to the financial crisis than they are after the financial crisis.

Shenai, Cohen, and Bergstresser (2010a) find bonds with insurance are more liquid than bonds without insurance prior to the financial crisis. Using a different set of measures of liquidity to validate the previous result provides the following two propositions:

Hypothesis 3. Prior to the insurers' downgrades bonds with insurance are more liquid than bonds without insurance.

Hypothesis 4. After the insurers' downgrades, bonds with insurance are less liquid than bonds without insurance.

The literature on the clientele effect discusses how a AAA rating is necessary for bonds to be held by certain institutional investors. The following hypothesis tests for the clientele effect.

Hypothesis 5. AAA-rated municipal bonds are more liquid than non $A A A$-rated municipal bonds.

In the next section I detail the methods employed to test the hypotheses above.

### 2.6 Methodology

### 2.6.1 Liquidity Measures

My choice of measures follows that of Han and Zhou (2008), who use three measures to analyze the effects of liquidity on the non-default component of corporate
bond yield spreads. I use turnover rate, estimated bid-ask spreads and the Amihud measure to investigate if municipal bond insurance provides liquidity to insured bonds. My choice of measures is also driven by the findings of Goyenko, Holden, and Trzcinka (2009) that investigate how well liquidity measures perform on a daily or monthly basis against well-known liquidity benchmarks. I detail these three measures below.

## Turnover Rate as Frequency Proxy of Liquidity

I use daily turnover rate, i.e. the ratio of the total trading volume in a day to the amount of face value outstanding, as a measure of trading frequency.

$$
{\text { Turnover } \text { Rate }_{t}}=\frac{\text { Volume }_{t}}{\text { Outstanding }_{t}}
$$

The general rationale when using the turnover rate as a measure of liquidity is that, the larger the turnover, the more liquid the bond. The theory put forth in Manconi, Massa, and Yasuda (2010) suggests that informationally insensitive assets are more liquid than informationally sensitive assets. Because insurance can make municipal bonds informationally insensitive to the fundamentals of the municipality, all else equal, I expect the turnover rate to be larger for insured municipal bonds. However, when the insurers are downgraded and the previously informationally insensitive bonds become informationally sensitive, I expect the uninsured bonds to have a higher turnover rate, as investors already know how to analyze the uninsured bonds. The market may not know how to price bonds that just became informationally sensitive or "sensitive to adverse selection" Gorton (2009), therefore bonds with insurance will trade less frequently.

## Roll Measure as Spread Proxy of Liquidity

To estimate the bid-ask spread I follow Roll (84) ${ }^{2}$ :

$$
\operatorname{BidAsk}_{t}^{i}=2 \sqrt{-\operatorname{Cov}\left(\tilde{p}_{j, t}^{i}-\tilde{p}_{j-1, t}^{i}, \tilde{p}_{j-1, t}^{i}-\tilde{p}_{j-2, t}^{i}\right)}
$$

where $\tilde{p}_{j, t}^{i}=\log p_{j, t}^{i}$ and $p_{j, t}^{i}$ represents the jth price for bond i on day t .
Roll's model demonstrates the effective bid-ask spread equals two times the square root of the negative covariance between the price changes in adjacent trades. In this

[^3]model a larger bid-ask spread creates larger bounces in bond prices, generating larger negative correlation, and therefore lower liquidity. The larger is the bid-ask spread, the less liquid is the bond. Because insured bonds are informationally insensitive and held by more people, I expect insured bonds to have smaller price changes, and thus smaller bid-ask spreads.

## Amihud Measure as Price Impact Proxy of Liquidity

The last measure of liquidity proxies for the price impact of trades. More liquid bonds are less impacted by any given trade. I use the commonly employed price impact measure introduced by Yakov and Amihud (2002). Goyenko, Holden, and Trzcinka (2009) find that Yakov and Amihud (2002) does well in measuring price impact in cases with low frequency of trade data, which is why I use the Amihud measure to proxy for the liquidity effect of municipal bond insurance on municipal bonds. The formula for the Amihud measure is:

$$
\text { Amihud }_{t}^{i}=\frac{1}{N_{t}^{i}} \sum_{j=1}^{N_{t}^{i}} \frac{\frac{\left|p_{j, t}^{i}-p_{j-1, t}^{i}\right|}{p_{j, t}^{i}}}{Q_{j, t}^{i}}
$$

where $p_{j, t}^{i}$ represents the jth price for bond i on day $\mathrm{t}, Q_{j, t}^{i}$ is the dollar size of the j th trade for bond i on day t , and $N_{t}^{i}$ is the number of trades for bond i on day t .

The Amihud measure is the average ratio of the absolute percentage change in bond prices over the dollar size of the trade. Measuring the price impact of a trade should be the clearest measure of liquidity in the municipal market. Since investors tend to hold bonds to maturity it will be harder to see frequency measures of liquidity, and the fact that we do not observe bid-ask spreads may create error in analyzing the bid-ask spread liquidity measure. Therefore, the effect of insurance on liquidity should be visible when measured by price impact. The larger the Amihud measure, the more illiquid is the bond.

### 2.6.2 Liquidity Tests

The next step is to look at the effect of insurance on liquidity. First I use the following regression to compare the liquidity of bonds with insurance to bonds without insurance:

$$
\begin{equation*}
\text { LiquidityMeasure }_{i}=\beta_{1} * \text { Insured }_{i}+\underline{\beta}_{k} * X_{i, k}+\underline{\beta}_{s} * \gamma_{s}+\epsilon_{i} \tag{2.1}
\end{equation*}
$$

where LiquidityMeasure $e_{i}$, represents the value of the liquidity measure for bond i. $\beta_{1}$ provides the unbiased estimate of the insurance effect on the liquidity measure. $X_{i, k}$ is a set of k control variables including issuer fixed effects, underlying rating, maturity, time since issuance and offering type. $\gamma_{s}$ represents state fixed effects.

I run the regression over varying time frames to see if insurance impacts liquidity differently over time. Insurance can provide different liquidity effects depending on the underlying rating. By only looking at the average liquidity effect of insurance the rating-specific liquidity effects might be overlooked. To account for this I subset the data and run the previous regression for each underlying rating.

The U.S. economy faced a financial crisis during the time I analyze. To account for the shock of the economic crisis, which I assume hit the municipalities in the same way, I estimate a difference-in-difference regression to look at the relative change in liquidity between municipal bonds with insurance compared to municipal bonds without insurance. A difference would reflect how insurance's effect on liquidity changed during the crisis.

The following regression captures the above hypothesis.

$$
\begin{align*}
\text { LiquidityMeasure }_{i} & =\beta_{1} * \text { Insured }_{i}+\beta_{2} * \text { PreEvent }_{i} * \text { Insured }_{i} \\
& +\beta_{3} * \text { PreEvent }_{i}+\underline{\beta}_{k} * X_{i, k}+\underline{\beta}_{i} * X_{i, k} * \text { PreEvent }_{i} \\
& +\epsilon_{i} \tag{2.2}
\end{align*}
$$

where LiquidityMeasure ${ }_{i}$ represents the liquidity measure for municipal bond i and $X_{i, k}$ is a vector of k standard controls as before. PreEvent $i_{i}$ is an indicator variable of whether the liquidity measure for bond i is measured before the municipal bond insurers financial trouble. I use two different events to proxy for a change in the insurers' ability to provide insurance. The first event is the time at which the insurers' stock price dropped, July 2007. The stock price imputes all information, so the date at which the stock price drops is when the market knows the insurers are in distress. The second event is when the insurers were downgraded, i.e. June 2008, at which point the insurers could no longer provide a AAA rating.

In order to test the hypothesis about the clientele effect I use the following regres-
sion as a robustness check to the previous rating-specific regressions.

$$
\begin{equation*}
\text { LiquidityMeasure }_{i}=\beta_{1} * A A A_{i}+\underline{\beta}_{k} * X_{i, k}+\underline{\beta}_{s} * \gamma_{s}+\epsilon_{i} \tag{2.3}
\end{equation*}
$$

where LiquidityMeasure $e_{i}$, represents the value of the liquidity measure for bond i. AAA is " 1 " if the bond's actual rating is AAA and " 0 " otherwise. $\beta_{1}$ provides the estimate of the liquidity effect for being AAA. $X_{i, k}$ is a set of k control variables including issuer fixed effects, maturity, time since issuance and offering type. $\gamma_{s}$ represents state fixed effects.

### 2.7 Results

The results for all three liquidity measures are consistent across regressions. Although the way in which I interpret the results varies according to the measure. The results suggest that bonds with insurance are less liquid than bonds without insurance before and after the financial crisis. The results do not vary with the choice of the event date. However, when the analysis is done on a monthly basis, more change in liquidity is evident. Both the Amihud measure and the turnover measure suggest that municipal bonds with insurance became less liquid after the insurers' rating downgrade. The bid-ask measure does not show any significant change in liquidity over the 2006-2009 time period.

I first analyze liquidity using the Amihud measure, which, as explained above, is a measure of price impact. Comparison of Tables 4.29 and 4.30 reveals that addition of issuer controls to regression 2.1 does not affect the significance or direction of the findings nor does controlling for the underlying rating as seen in Table 4.31. The coefficient on the insured dummy is positive and significant in each case, implying that insurance decreases liquidity, because a larger Amihud value corresponds to a less liquid bond. This result is somewhat surprising given my hypothesis that insurance ex-ante would increase the liquidity of bonds. The finding that bonds with insurance have lower liquidity then bonds without insurance after the stock price drop or ratings downgrade is in line with what I expected. The results suggest that Hypothesis 2 and 3 are false while supporting Hypothesis 4. I comment on Hypothesis 1 further down.

I use three different measures of liquidity because liquidity is hard to define and even harder to capture. The results from the Amihud regression go farther in showing the difficulty of measuring liquidity not because of the coefficient on the insured
dummy, but because of the number of observations for each regression. The number of observations represents the number of bonds that traded over the time frame. In order for a bond to be counted it needs to have traded three times on a given day. The tables show that, prior to the insurers' stock price drop, there are 48,255 trades but, post insurer stock price drop, there are 341,261 trades. The price impact of an insured bond may still be higher than the price impact of an uninsured bond, but there are more bond trades after the insurers' stock price drop. A similar pattern holds for the insurers' rating downgrade. The number of days prior to the insurers' rating downgrade is larger than the number of days after the insurers' rating downgrade, so a difference in number of trade days cannot explain the difference in number of observations pre and post crisis.

Most of the controls in the regression are significant at the one percent level, these include log maturity, a size dummy, time outstanding, log issue size and log bond size. The Amihud measure is increasing, suggesting less liquidity, in all these controls across all sample periods, except for log issue size. The intuition for why these controls have a larger Amihud measure depends on the control. The size dummy is a one or zero indicator of whether the trade is greater than 100,000 dollars, so the larger is the trade, the larger is the price impact and hence the larger is the Amihud measure. Time outstanding represents the length of time since a bond was issued. The result that liquidity is decreasing in time outstanding, is in line with the empirical fact that more trades occur at time of issuance. The finding that the Amihud measure is increasing in maturity follows if the typical holder of longer maturity municipal bonds are long term investors who do not sell bonds often. The finding that the Amihud measure is decreasing in log issue size suggests that municipalities who issue larger issues are more liquid in the market.

To answer the first hypothesis Table 4.32 breaks down the findings of Table 4.29 and 4.30 by insurer. While the results for the controls do not change, I find that the insurer does not make a difference. In that all insurers appear to reduce the liquidity of municipal bonds. While I would expect the effect of the insurer to be the same before the crisis, I would have expected the coefficient on the Assured dummy to be the same after the crises. Because Assured Guaranty is the one insurer that maintained a AA+ rating throughout the crisis. In terms of the Amihud measure, Hypothesis 1 is false in that the downgrading of insurers does not seem to impact the change in liquidity as it happens across all insurers.

I next look at the difference between the difference in insured bonds and uninsured bonds before and after the crisis. The coefficients on the interaction between an
insured dummy and pre-event dummy are significant, depending on whether I use the date of the insurers' stock price drop or the date of the insurers' downgrade as an event date. This suggests that while the level of liquidity in the market may have changed (as suggested by the number of observations), the difference in liquidity between bonds with insurance and bonds without insurance has not changed as a result of the insurers' stock price drop. There is a significant increase in the difference between the liquidity of bonds with insurance and bonds without insurance. This implies that the insurers' ability to improve municipal bond ratings provides the liquidity benefit for municipal bonds. This result support Hypothesis 5.

Using the bid-ask measure and running the same regressions yield the same results both in terms of significance of coefficients and trend in the number of observations. The significant coefficient on the insured dummy suggests that, no matter the time period, insured bonds have a higher bid-ask spread, meaning that bonds with insurance are more illiquid than bonds without insurance. While the number of observations is different from the Amihud measure regressions, the pattern remains that, prior to the insurers' stock price drop, there are less observations than after, and the same is true for the insurers' rating downgrade. This is also true for the turnover measure, which suggests that there was more market activity post-crisis than pre-crisis.

These results suggest that this could be due to fire sale type circumstances, which is not what this paper is considering when using the term liquidity. Also this paper's focus is on the effect of insurance on liquidity, whereas the total number of observations speaks to the level of liquidity in the market. The coefficients on the control variables for the regressions using the bid-ask measure provide the same results as the control variable coefficients for the Amihud measure.

There is a difference between looking at the bid-ask spread value before the insurers' stock price drop and before the insurers' rating downgrade when breaking down the results by insurer. Results are consistent across insurers, which lends support of Hypothesis 1 being false and provides support in favor of Hypothesis 2. I find that the coefficients on the individual insurer dummies prior to the insurers' stock price drop are not significant. This could be for two different reasons. Either there is not enough data to separate out the different insurer effects or there is no difference in liquidity as measured by bid-ask spread prior to the insurers stock price drop. Given the result that insured bonds are significantly less liquid than uninsured bonds after the stock prices drop, suggests that being insured decreased municipal bonds level of liquidity. Since this result is not picked up when using the insurers' rating downgrade as the event, it further suggests that it is not the rating that provides the liquidity
but rather the insurers' financial health provides liquidity. I further test for the difference between insured and uninsured bonds before and after the two different event dates by running a difference-in-difference regression as before. The findings show that the difference before the stock price drop was smaller than the difference after the insurers' stock price drop. This can be seen in Table 4.50 where the coefficient on the interaction between an insured dummy and a prestock dummy is significant at the 10 percent level. So insured bonds became less liquid relative to uninsured bonds as expected in Hypothesis 1. However, this result goes away when I control for underlying ratings.

Analyzing liquidity by using the turnover measure results in the same conclusions drawn previously with the Amihud measure. The greater is the turnover value, the more liquid is the bond, so the finding of a negative coefficient on the insured dummy in Tables 4.53 and 4.54 can be interpreted as insured bonds being less liquid than uninsured bonds over each of the specifications. The coefficients for the controls are similar in interpretation to the Amihud measure except for log issue size and log bond size. Log issue size has a negative coefficient, suggesting that larger issues are less liquid but larger bond sizes are more liquid. Looking at the amount of observations before and after the different event dates reveals that there are more trades after an event than before. The turnover measure requires less trades per bond to calculate, than the two prior measures, so given the difference in trades before and after the financial crisis it becomes clear there is much more trading taking place after the financial crisis.

The breakdown of the effect of insurance on liquidity by insurer for the turnover measure reveals that insured bonds are less liquid than uninsured bonds. All the insurers both before and after the crisis decrease the turnover value and hence liquidity of municipal bonds. The difference-in-difference regression tells a story similar to the bid-ask measure. I find that there is a significant difference between the difference in insured and uninsured bond liquidity before and after the event dates. The coefficient on the interaction between an insured dummy and stock price drop dummy is negative and significant at the one percent level. This suggests that the difference between insured and uninsured bonds got larger over time, which supports the implication that insurers' financial health provides liquidity.

Starting with the Amihud measure and looking at the pure rating of AA, it appears that, after the crisis, uninsured AA bonds were more liquid than insured AA-rated bonds. While not significant, the value of the coefficient for insurance before the stock price drop suggests that AA insured bonds were more liquid than AA unin-
sured bonds. However, the other measures suggest that AA bonds with insurance are less liquid than AA without insurance. This could mean that a well-known municipality has a larger market appeal than an insurer in a market dominated by insured municipal bonds. Next analyzing bonds with an A rating yields the same results, that bonds with an A underlying rating and no insurance are more liquid than A-rated bonds with insurance. This trend is the same across all measures.

Insurance might not provide a liquidity benefit to compensate for the liquidity of a municipal bond that does not have insurance, but perhaps looking at actual ratings may suggest otherwise. First, I look at municipal bonds with an actual rating of AAA, and I find across the Amihud measure and turnover measure there is significant evidence that natural AAA-rated bonds are more liquid than insured AAA-rated bonds. An interesting result in the data comes from looking at actual A-rated municipal bonds. The data shows that bonds that use insurance to get an A rating are more liquid than natural A-rated bonds. While the result is not significant for the Amihud measure or the turnover measure, the coefficient has the right sign to indicate insurance provides liquidity. The bid-ask measure does not support the previous finding. The results suggest that insurance does not increase liquidity relative to the liquidity of bonds that do not purchase insurance. As a robustness check for hypothesis 5, a regression of liquidity value on AAA status and controls is run, and the results suggest that during 2006-2009 AAA-rated municipal bonds were less liquid than non-AAA rated municipal bonds. This is more evidence that hypothesis 5 is false.

The last part of the analysis looks at the coefficient on the insured dummy by month relative to the coefficient on the insured dummy for July 2007. Unfortunately I am not able to produce these graphs by rating or insurer, due to too few observations on a ratings or insurer level. The graphs show a significant relative change to July 2007 after June 2008. The bid-ask measure stays relatively constant with no significant difference from its July 2007 level, suggesting there is no change in liquidity due to changes in the insurers' quality. The graph of coefficients on the insured dummy for the Amihud measure shows that coefficients are significantly lower than the July 2007 level until about June 2008 where it appears to be significantly larger going forward. After controlling for underlying bond ratings, the previous result goes away. This suggests that insurance was increasing liquidity prior to the insurers' rating downgrade but after the downgrade insurance was reducing the liquidity of the insured bonds. The graph for the turnover measure provides support for half of the story told by the Amihud measure graph. The coefficient on the insured dummy for the turnover measure is not significantly different from July 2007, but looking at June

2008 the coefficient is significantly lower than July 2007. This suggests that after the downgrade of the insurers, insurance was decreasing the liquidity of the municipal bonds while before the downgrade there is no evidence that insurance was increasing liquidity as measured by the turnover measure.

### 2.8 Conclusion

This paper analyzes the effect of insurance on liquidity, using the financial crisis as the time period over which to analyze the impact of municipal bond insurance. I choose two different dates to proxy for when insurance might have stopped providing a benefit. One is the date at which the insurers' stock price dropped, and the second is the date when the insurers' were first downgraded. Three different measures are used to proxy for liquidity. These measures are the Amihud measure, which captures the price impact aspect of liquidity, Roll's bid-ask spread, which captures the ease of trade aspect of liquidity, and turnover, which measures the amount of trading aspect of liquidity.

I hypothesize that insurance improves liquidity and that the removal of insurance negatively impacts the liquidity of insured bonds. I find municipal bonds with insurance have lower liquidity than municipal bonds without insurance. This finding holds both before and after the financial crisis for all liquidity measures. When comparing the liquidity of bonds with insurance prior to the crisis to bonds with insurance after the crisis, most measures find that there is a statistical difference. These results suggest that insurers do not provide a liquidity benefit. The bid-ask measure finds no evidence that, relative to uninsured bonds, the liquidity of insured bonds decreases after the insurers' stock price drops.

Looking further at the liquidity of insured bonds relative to uninsured bonds by month suggests that insured bonds' liquidity decreases after the insurers' rating downgrade. Both the Amihud measure and turnover measure demonstrate a statistically significant change in the effect of insurance on liquidity. The liquidity effect of insurance decreases starting in June 2008 during the downgrade of the insurers.

This paper breaks down the liquidity benefit of insurance by pure and actual rating, I find that at a rating level insurance does not improve liquidity. As a robustness check, the liquidity value was regressed on a AAA dummy and controls and the result is that during the financial crisis non-AAA rated bonds were more liquid. Other papers show municipal bond insurance lowers the yields at which municipal bonds trade. This paper suggests that the yield is lowered due to a positive externality
associated with liquidity.

## Chapter 3

## A Municipal Bond Market Index Based on a Repeat Sales Methodology

### 3.1 Introduction

Indices play an important role in revealing trends within a given market, determining the efficiency of a market, and pricing securities. Pricing securities is more important now than ever, as the need for institutions to use mark to market pricing increased drastically, as a response to the current crisis. In markets with high frequency trading, marking to market is less critical, but in markets where securities trade less often, determining the market price is more challenging. Indices act as a benchmark around which pricing is focused, so making sure indices are accurate is extremely important. Especially in markets with low liquidity, where it is hardest to create practical indices.

The stock market, which arguably is the most liquid market, has numerous indices that track its performance. On the other hand the real estate market, which is less liquid, has less indices to track its performance. The biggest advance in real estate indices was the S\&P Case Shiller Index, which is a repeat sales index that has many flaws but is the most commonly used proxy for the trends in the real estate market. The municipal bond market, the focus of the present paper, is similar to the real estate market in many facets, including low liquidity.

The municipal bond market is comprised of over 50,000 issuing entities with over 1 million issues outstanding. The average bond trades about nine times per year.

In a market where securities trade so infrequently it is difficult for an institution to mark to market their securities. As regulators are playing larger roles it becomes increasingly important for institutions to use an accurate method for pricing their municipal bonds.

Currently there are two major indices in the municipal bond market computed by S\&P and the Bond Buyer. While there are many shortcomings with those indices, a main concern is that neither one is calculated based on actual trades. The Bond Buyer uses estimates provided by municipal bond traders, while S\&P takes daily pricing data from its own securities evaluation department. Standard and Poor's Securities Evaluation (SPSE) provides daily estimates of pricing data for bonds that have not traded. In this paper I propose a new index that uses actual trade data. By using trade data I suggest that the new index provides a more accurate estimate of trends in the municipal bond market and allows for a more accurate mark to market pricing for institutions holding illiquid municipal bonds.

The methodology used to create this new index comes from the Case Shiller Repeat Sales Index. By adjusting the repeat sales methodology to work with municipal bond data one can create an index based on municipal bond transactions as opposed to estimates of bond prices, which is the way the current municipal bond market indices are calculated. Another benefit of the repeat sales methodology is the ability to compute multiple indices to proxy for trends in different rating classes, maturities, or any other grouping of interest. In particular, it also allows one to create indices based on dealer-to-dealer pricing, which is thought to be a more accurate measure of a bond's price or on customer-to-dealer trades, which reflect the market power of the dealer. While there is literature on different indices and repeat sales indices in the real estate market, there is no literature on indices in the municipal bond market. The closest paper is Harris and Piwowar (2006), who briefly mention creating a long term and short term indices to help them calculate transaction costs. They mention that they use repeat sales methodology, but do not include any other information on how they are calculating the index values.

The remainder of this paper is organized as follows. The next section provides a background on existing indices. Section 3 describes my methodology. Section 4 discusses the data and presents descriptive statistics. Section 5 presents the estimation results. Section 6 shows a horserace between my index and the existing municipal indices. Section 7 concludes.

### 3.2 Background

The Bond Buyer produces many municipal bond indices in an attempt to pick up trends in different parts of the market. The Bond Buyer's indices look separately at general obligation (GO) bonds, revenue bonds, and the overall market. The S\&P municipal bond indices cover a larger range of categories than the Bond Buyer indices, but they are calculated in much the same way. S\&P takes averages of pricing estimates provided by its securities evaluation department instead of asking bond traders. By using survey type estimates instead of actual trade prices these indices are not picking up the dynamics of the true market value.

### 3.2.1 Bond Buyer Indices

The Bond Buyer's 20-Bond Index uses 20 general obligation bonds that mature in 20 years to provide an estimate of the trend in the municipal bond market. Because of the small sample size any issuer-specific effects have a large impact on the index value. The Bond Buyer also has an 11-Bond Index that selects 11 bonds from the 20Bond index. Both indices are meant to proxy for the trends in the general obligation bond market. The 11-Bond Index has a higher average rating, AA+ then the 20Bond Index with an average rating of AA. The revenue index created by the Bond Buyer uses 25 revenue bonds that mature in 30 years to estimate trends for revenue bonds. The Bond Buyer description of their indices is as follows: "The indexes represent theoretical yields rather than actual prices or yield quotations. Municipal bond traders are asked to estimate what a current-coupon bond for each issuer in the indexes would yield if the bond was sold at par value. The indexes are simple averages of the average estimated yield of the bond."

### 3.2.2 S\&P Indices

S\&P provides a rule-based methodology for creating their index so that the index will be transparent to investors. Municipal bonds are eligible for an S\&P index if they are held by a mutual fund and SPSE provides daily pricing on the bond. Also the eligible bond must have a par amount over 2 million dollars and more than 1 month left to maturity. S\&P provides a family of indices covering different municipal sectors and bond characteristics such as maturity, insurance status, state, and bond type (general obligation or revenue). The S\&P indices have a base date of December 31, 1998 with a base value of 100 . While the manner in which SPSE produce municipal bond prices
is unclear the method used to create the S\&P indices is detailed thoroughly. S\&P indices are market value weighted indices. Documentation produced by S\&P explains the way in which they calculate the total return. "The total return is calculated by aggregating the interest return, reflecting the return due to paid and accrued interest, and price return, reflecting the gains or losses due to changes in SPSE's end-of-day price." (SPi 2012)

### 3.2.3 Repeat Sales Municipal Bond Market Index

The municipal bond market is similar to the housing market in many ways. The municipal bond market has over 40,000 trades a day although a bond on average trades only nine times a year. This parallels the real estate market, where there are thousands of houses being traded daily, but each individual house trades infrequently. The municipal market has over 50,000 issuers with over one million securities outstanding. Similarly, the housing market has over 100 million issuers with over a 100 million houses. The above characteristics of these markets all lead to the idea that both markets are illiquid with opaque information due to a large number of issuers. Besides the markets similarity, the assets being traded have other important traits in common. Municipal bonds, like houses, are typically held for long durations and have characteristics that do not change over time. While house characteristics can change over time (i.e. remodeling) there are plenty of houses that remain the same. The one bond characteristic that does change over time is maturity. The parallel in the real estate market is houses age over time.

Both markets find it difficult to price assets that do not trade often. While the real estate market has addressed these issues through indices such as S\&P Case Shiller index, the municipal bond market has yet to address this problem, which will be exacerbated due to new regulations. The new regulations require institutions to use mark to market pricing instead of using ratings in calculating their capital requirements for municipal bonds.

There are a few problems with the repeat sales index used in the real estate market. The intuition behind repeat sales methodology is that when an asset trades multiple times and has not materially changed over that time, price movements are attributable only to market forces, and thus an indicator of how the market's pricing has changed. In the real estate market difficulties in determining accurate prices arise when the house that is being traded has been remodeled because the asset has materially changed, therefore the change in price is not simply due to market dynamics. Sometimes the transactions are not arms length transactions, which means the sellers
and buyers know each other, and the price of the transaction is not the market value of the house. To address these issues Case and Shiller remove transactions that meet the previous conditions.

The municipal bond market does not have the same difficulties as the real estate market but has problems of its own. The municipal bonds themselves do not change over time. There are two characteristics of the bond that can change over time, and one that absolutely changes over time. The underlying credit quality and municipal conditions can change over time, while the maturity of the bond changes over time. In the real estate market house age changes over time and the Case Shiller index ignores this challenge. To address the maturity problems I do not allow bonds with less than one year to maturity to be in the index, and trades within the same bond need to have taken place within five years from each other. While these restrictions do not fully resolve the maturity issue, there is a possibility the index will reflect some change due to changes in bond maturity.

The underlying credit quality of the municipality can change over time, which will affect the bond price even though the bond features have not changed. The degree of increase in bond transactions due to underlying municipal quality change will determine the extent of the bias in the index, because one shortfall of repeat sales indices is only those assets that transact are in the index. If there are differing reasons, such as bond quality, for why certain bonds trade it will not be reflective of the entire market. However, given that the issuing entities are cities and states, conditions do not change nearly as fast as for individuals, and looking at trades that happened within five years of each other also helps to resolve this issue.

Two more traits change over time, which are not bond characteristics, but still affect bond pricing. One characteristic is the interest rate. While the municipal bond index reflects fixed rate bonds, which means their coupon payments will not change, the interest rate in the market is always changing. I try to control for this by using municipal bond yields. The second characteristic is tax effects. One of the benefits of municipal bonds is their tax exemption, so it is important to notice that tax law changes will change the way municipal bonds are priced.

One last characteristic that does not change over time is the state in which the bond is issued. The bond's state of issue will affect pricing if the state changes its policies that affect its municipal bonds. While the state effect is picked up in geography-specific repeat sales indices, it will not be compensated for in the overall municipal bond market index. After controlling for characteristics that change over time the repeat sales index is reflective of only the movement due to changes in market
pricing.

### 3.2.4 Differences Between Indices

The main difference between the repeat sales methodology and the current indices for the municipal bond market is the repeat sales index is based on transactions, while the other indices are based on analysts estimate of prices. Because the repeat sales index uses transactions, it will provide a more accurate estimate of the market price of a municipal bond. The two main indices I compare with the repeat sales index are the Bond Buyer indices and the S\&P municipal bond indices. The Bond Buyer use at most 40 bonds and at least 11 bonds to create its different indices.

The Bond Buyer indices have many shortcomings, which include a changing composition and limited sample size which may or may not be representative of the municipal bond market. The use of such a limited sample allows idiosyncratic shocks of an issuer to have a large effect on the index value. It is hard to interpret what a change in the index value means because the change could be coming from the evolving composition of the index or this could be a a change in maturity or underlying credit quality in the case of bonds that stay in the sample. They also do not make an attempt to control for the changing interest rate environment.

The S\&P family of indices incorporates all bonds with a par value of greater than 2 million dollars outstanding and longer than one year left to maturity. S\&P selects bonds for inclusion in the indices in a manner that aims to create a representative sample. Like the Bond Buyer indices, S\&P indices use an average of estimates to calculate their index. Using an average gives a snapshot of the market at a given time, but does not allow investors to see how the market is changing over time, as it fails to account for changes in maturity and underlying bond quality affecting prices. If the bond price estimates were accurate then the need for an index would be focused on market trends and not on pricing. If the bond prices are not accurate then the $\mathrm{S} \& \mathrm{P}$ index is inaccurate as well.

### 3.2.5 Index Possibilities

I present a methodology that has not been used in the municipal bond market before to create a more municipal bond market index. A benefit of this methodology is the extent to which it can provide indices on separate characteristics of municipal bonds. It can be used to create indices of categories including an index for general obligation bonds, another one for revenue bonds, indices based on rating quality,
insurance status, state of issue, or any combination of the previous characteristics. The repeat sales index is limited only by the fact that there needs to be enough repeat sales in the sector which the index is targeting. Since the municipal bond market is not highly liquid, this can be a concern.

### 3.3 Data

I merge three different data sources to create a comprehensive municipal bond database. Municipal Securities Rulemaking Board (MSRB) provides the municipal bond transactional data for customer to dealer trades, dealer to dealer trades, and dealer to customer trades for the four year period covering 2006-2009. Standard and Poors (S\&P) provides the ratings and bond characteristic data. Additional characteristic data was obtained from Bloomberg.

The MSRB transactional data contains over 20 million transactions on over 700,000 individual long-term municipal bonds. I match the transactions with data from S\&P. The S\&P data contains standard ratings, standard rating changes, S\&P Underlying Rating (SPUR) if available, SPUR changes, and bond characteristics from 1989 to 2009. A SPUR represents the rating of a bond without credit enhancement. If credit enhancement does not exist for the bond, then the SPUR rating will not exist. However, bonds without a SPUR may have credit enhancement. For each transaction I match the bonds most recent rating prior to the transaction date. So each bond has the most up to date underlying rating at the time of the transaction. I supplement each transaction with Bloomberg data including callability, maturity, offering type, coupon, issue size, bond size, and state in order to control for bond characteristics. All data sets are matched by cusip. I remove transactions that are negative or 0 as they are an error in the data. I am left with over 13 million transactions. In order to calculate an index for a particular market segment I further breakdown the sample according to what the index covers.

Merging the three sources yields a data set that covers all daily municipal bond secondary transactions from 2006 to 2009 . I provide the composition of municipal bonds that compromise each index. The mean coupon by index is between 4 and 4.7 percent, while the average time to maturity is around 10 years except in the case of the maturity specific indices. The bond size represents the par amount outstanding of the bond when it was issued and averages around four million dollars but is larger for the longer term maturity indices. The number of different bonds in a given index varies anywhere from 5,820 to 373,213 . To be included in the index a bond needs
to have traded on two different days. Looking at a breakdown of the geographic composition by index gives around 17 percent of bonds coming from California, 7 percent from New York, 13 percent from Texas and 60 percent from other states. For the geographic specific indices all bonds come from the specific state of the index. A breakdown of composition by bond type (i.e general obligation or revenue) shows about 45 percent are general obligation bonds and 55 percent are revenue bonds except in the 30 year maturity index where general obligation are only 21.3 percent. I further look at the ratings composition of the indices and find around 50 percent of bonds are AAA, 30 percent are $\mathrm{AA}, 15$ percent are A and 1 percent are $\mathrm{BBB}+$. Exclusions apply for the rating specific indices. Further summary statistics can be found in tables 4.65, 4.66, 4.67, and 4.68 in the appendix.

### 3.4 Methodology

The statistical methods contained in this section can also be found in Calhoun (1996). I will provide their method and what changes have been made. I start with bond level transaction data reported at the time of the trade. The repeat sales index will be calculated at a larger time interval then intra day, so I calculate one bond price per day of trade which is the average of all bond specific transactions on a given day. I then remove all bonds that have not traded within five years of their last trade.

For my approach I have assumed bond yields, $Y_{i t}$, can be expressed in terms of a market yield index $\beta_{t}$, a Gaussian random walk $H_{i t}$, and white noise $N_{i t}$, such that

$$
\begin{equation*}
Y_{i t}=\beta_{t}+H_{i t}+N_{i t} \tag{3.1}
\end{equation*}
$$

Then the total change in yield for bond i transacting in time periods $s$ and $t$ is given by

$$
\begin{align*}
\Delta V_{t} & =Y_{i t}-Y_{i s} \\
& =\beta_{t}-\beta_{s}+H_{i t}-H_{i s}+N_{i t}-N_{i s} \tag{3.2}
\end{align*}
$$

The market index $\beta_{t}$ represents the average behavior of municipal bond values in a given market, and remains unrestricted. The Gaussian random walk $H_{i t}$ describes how variation in individual issuer growth rates around the rate of change in the market index can cause municipal bond yields to disperse over time. The white noise term $N_{i t}$ represents cross-sectional dispersion in municipal bond values arising from purely
idiosyncratic differences in how individual municipal bonds are valued at any given point in time. The difference in yields can more generally be expressed as

$$
\begin{equation*}
\Delta V_{i t}=\sum_{\tau=0}^{T} Y_{i \tau} D_{i \tau} \tag{3.3}
\end{equation*}
$$

Where $D_{i \tau}$ is a dummy variable that equals 1 if the yield of bond i was observed for a second time at time $\tau,-1$ if the yield of bond i was observed for the first time at time $\tau$, and zero otherwise. Substituting equation 3.1 for $Y_{i t}$ yields:

$$
\begin{align*}
\Delta V_{i t} & =\sum_{\tau=0}^{T}\left(\beta_{\tau}+H_{i \tau}+N_{i \tau}\right) D_{i \tau}  \tag{3.4}\\
\Delta V_{i t} & =\sum_{\tau=0}^{T} \beta_{\tau} D_{i \tau}+\epsilon_{i} \tag{3.5}
\end{align*}
$$

The $\beta_{t}$ parameters for the market index are then estimated using ordinary least squares (OLS) regression. The results of the OLS regression of equation 3.4 on the municipal bond transactions are used to construct the squared deviations of observed municipal bond yields around the estimated municipal bond market index. The predicted bond yield in period $t$ is the original yield plus expected market appreciation and the squared deviations of observed municipal bond yields from the market index are given by:

$$
\begin{align*}
d_{i}^{2} & =\left[Y_{i t}-\hat{Y}_{i t}\right]^{2}  \tag{3.6}\\
& =\left[Y_{i t}-Y_{i s}-\hat{\beta}_{t}+\hat{\beta}_{s}\right]^{2} \tag{3.7}
\end{align*}
$$

Using the assumption behind the stochastic process assumed for bond yields, which are detailed in Calhoun (1996) and assuming $N_{i t}$ is a constant it can be shown that this expression has expectation given by:

$$
\begin{equation*}
E\left[d_{i}^{2}\right]=A(t-s)+B(t-s)^{2} \tag{3.8}
\end{equation*}
$$

Next I estimate a second-stage regression of $d_{i}^{2}$ on $(\mathrm{t}-\mathrm{s})$ and $(t-s)^{2}$ to provide consistent estimates of A and B. I then use the predicted values of $d_{i}^{2}$ to derive the weights needed to obtain Generalized Least Squares (GLS) estimates of the $\beta_{t}$, parameters in
the following regression:

$$
\begin{equation*}
\frac{\Delta V_{i t}}{\sqrt{\hat{d}_{i}^{2}}}=\sum_{\tau=0}^{T} \beta_{\tau} \frac{D_{i \tau}}{\sqrt{\hat{d}_{i}^{2}}}+\frac{\epsilon_{i}}{\sqrt{\hat{d}_{i}^{2}}} \tag{3.9}
\end{equation*}
$$

Equation 3.9 can be estimated for selected bond types, ratings, geographic areas, insurance status or any other category to derive municipal market indices. Index numbers for periods $\mathrm{t}=1,2,3, \ldots, \mathrm{~T}$ are given by:

$$
\begin{equation*}
I_{t}=100 * e^{\hat{\hat{\beta}_{t}}} \tag{3.10}
\end{equation*}
$$

where $\hat{\hat{\beta}}_{t}, \mathrm{t}=1,2,3, \ldots, \mathrm{~T}$ are the GLS parameter estimates. Assuming as I did before that $N_{i t}$ is a constant constrains the estimated error variance associated with the distribution of individual bond yield appreciation rates to be positive. This is consistent with the interpretation of changes in individual bond values as a diffusion process and the fact that the actual change in bond values must be zero until some time has elapsed.

### 3.5 Discussion

In order to analyze the repeat sales municipal bond index I first create 15 different indices for the municipal bond market. I create an index using all municipal bond transactions with over a year left until maturity. Bonds with a year or less until maturity are left out because that is the convention in the municipal bond market. Also bonds with less than a year left have the problem of being so close to maturity that there will not be any factors to pricing the bond except for the par value received upon maturity since there is no time for any risks to play a factor. I also create 14 sub-indices for different sections of the municipal bond market. One can create a sub-index for any characteristics they are interested in. However, I create indices for the sub divisions of the municipal market that investors are commonly interested in which includes; indices for different rating groups (AAA, AA, A , and $\mathrm{BBB}+$ ), maturity groups ( $5,10,20$, and 30 years), by state for California and New York (the two states with the most transactions), insured, uninsured, general obligation, and revenue. S\&P have indices for these groups as well, which allows for a comparison of indices.

The repeat sales rating indices use the $\mathrm{S} \& \mathrm{P}$ standard rating of the bond (the bond
rating including any credit enhancement or insurance) and any bond with a standard rating of $\mathrm{AA}-, \mathrm{AA}$ or $\mathrm{AA}+$ is included in the AA index, the same being true of the A index. The BBB+ index is comprised solely of BBB+ rated bonds.

The maturity group indices use bonds with the corresponding amount of time to maturity. For Bonds that do not have exactly 5, 10, 20 or 30 years until maturity I round to the closest category so 2 to 7 years falls in the 5 year index, 8 to 14 fall in the 10 year index, 15 to 24 falls in the 20 year index, and any maturity above 24 is included in the 30 year index. This varies from the $\mathrm{S} \& \mathrm{P}$ indices based on maturity where the long term index is any bond with an 8 to 15 year maturity. Splitting up the maturity as I did made the most sense to me in thinking about what investors might care about but the indices could easily be changed to group different years.

The first part of the results looks at the set of 15 indices I created and compares them to each other. I analyze the benefit of having multiple indices to look at trends in the municipal bond market. I find the correlations between indices to be high suggesting not much is gained from a trend standpoint by having indices for different market segments. The next part of the analysis compares the repeat sales indices with the S\&P indices, the Bond Buyer indices and Moody's Indices. The indices can be created for any frequency over which enough trades exist. For the purpose of this study I run the indices on a monthly basis to better compare them with S\&P indices that are created on a monthly basis. Also using a monthly basis provides enough transactions to compute all the indices. Above I discuss the problem of maturity decreasing over time and using a repeat sales index. While this is a problem that can be reduced by constraining transactions to a 5 year window there is another issue of bonds with differing maturities. The issue is related to the yield curve and the fact that bonds of differing maturities will naturally have different yields, this can be seen in the yield curve, which is typically not flat. With a repeat sales index the same bond is being looked at, however, when computing the index all bonds are taken into account so if there has been a shift in the yield curve bonds will change according to how the yield curve has changed. If the index does not adjust for this change the trend in the municipal market will be biased because it will be incorporating the change due to the yield curve shift. I am not able to control for the yield curve shift. Initially, I tried using the municipal bond yield spread, which is the difference in yield between a municipal bond and a treasury bond of equivalent maturity. However, when treasury rates shift faster than municipal bond rates a large bias is created. The three main methods one could use to calculate the repeat sales index are by using the log prices of the transactions, yields of the transaction or the yield spread I discussed above. I
calculate the index for all three ways but present the results for bond yield for the reasons given above. Over the four year span of data the results do not vary much depending on the metric used, except in the extremes. Since one of the main ideas behind the index is for a tool that can be used to help in municipal bond pricing I look at transactions that are from investors to dealers. The index can be computed using dealer-to-dealer prices or transactions from dealers to investors. In considering pricing I chose to create an index around the price an investor would get for selling the asset.

### 3.6 Results

The graphs in the appendix track the municipal bond repeat sales indices over the 2006 to 2009 time period. I analyze how the indices relate to real events, I will then compare the separate indices to each other and finally look at how the repeat sales indices compare with the indices already in practice.

The repeat sales indices track the municipal bond market through one of the economies biggest recessions. Although there were not many municipal defaults there was a lot of uncertainty in the municipal bond market, which shows up in the graphs. Looking at the overall market index, municipal bond yields varied from January 2006 to July 2007 increasing by as much as 40 percent. In July 2007 the market is aware of the declining financial health of the municipal bond insurers although it is not until June 2008 that the insurers are downgraded for the first time. In November 2008, AMBAC is downgraded to an A rating. The index reflects these market events in that, July 2007 is a high point before yields drop until January 2008. The index tracks market trends because in June 2008 yields increase a little bit at the uncertainty surrounding the insurers but peaks in November once the market knows what is happening with the municipal bond insurers. Then in 2009 the index changes direction steeply dropping to levels 70 percent of 2006 levels. This coincides with the flight to quality discussed in the financial crises literature. Where investors were looking for safe assets and bidding up price and yields down. The municipal market is linked to the treasury rate and in 2009 the fed started quantitative easing and dropped the market interest rate. Overall the market index seems to track the municipal bond market, it shows that from a base year of 2006 yields doubled during the crisis, but are now far below where they were in 2006.

Comparing the indices created based on certain characteristics presents validation of how the market values these characteristics. The highest rating categories AAA,
and AA both have a lower peak value and a lower bottom value than the lower rating categories. While the two indices track fairly well with the overall market index, during the July 2008 to January 2009 time period bond yields did not change as much for AAA, and AA municipal bonds as they did for the market as a whole. This seems reasonable given these are the safest credit quality bonds, which also explains why they decrease to levels below the overall market by December 2009. One would expect these indices to have a smaller variance then the overall market, which can be confirmed by looking at table 4.69. The lower two rating groups, A and $\mathrm{BBB}+$ tell a different story from the previous two rating groups. The indices for A and $\mathrm{BBB}+$ have a much larger variance and have the highest index value of any of the separate indices. While the overall pattern of these indices appear consistent with the rest of the municipal bond market the peaks during August 2008 to January 2009 show bond yields more than triple but by the end of 2009 bond yields are around January 2006 levels instead of at a new low like other rating indices.

In comparing the general obligation (GO) index to the revenue index, I would ex-ante expect the GO index to be less volatile, have a lower peak value and lower index value towards the end of the sample than the revenue index. The data shows that while the variation between the GO and Revenue index are not that different the peak and troughs for the general obligation index are lower than for the revenue index. The general obligation index has a steeper downward trend than the revenue bond index.

As I mentioned previously, during this time the municipal bond insurers experienced a financial shock due to their business in the credit default swap (CDS) market. Eventually leading to the insurers being downgraded and for some bankruptcy. It is interesting to look at the change in yields over 2006-2009 for insured municipal bonds because of the insurers financial trouble. The insured index follows the same trend as the rest of the indices in terms of the timing and direction of yield changes. When the insured index is compared with the uninsured index a steeper downward trend in the index value over the entire time frame is evident in the uninsured index. Also the uninsured index drops 40 percent from January 2006 levels before a large increase in yields during August 2008, which only increase yields 50 percent above the January 2006 base month. The duration of the increase in bond yields is also shorter for the uninsured bonds as bond yields start to decrease the month after November 2008. Towards the end of the sample the uninsured bond yields are lower than the insured bond yields relative to January 2006 base level. While no new information came to light about uninsured municipal bonds, the uncertainty of the municipal bond insur-
ers affected the yields for insured bonds and this difference is evident in looking at the two graphs. Comparing the insured index with the revenue index suggests that most of the revenue bonds that traded are insured bonds as the two indices are nearly identical. The uninsured bonds are represented in the revenue index, in the fact, that the peak and trough of the revenue bond index are lower than the insured bond index although this difference is slight at 7 percent.

The geographic-specific indices reflect how different credit qualities are among states. New York and California indices show the same overall pattern as the municipal market index. In comparing the two state indices New York is the safer state as it has a slightly lower volatility and has less of an increase in bond yields during the August 2008 time period. Towards the end of the sample bond yields on New York bonds dropped faster and lower than bond yields on California bonds.

The last indices I analyze are based on maturity. I examine four different groups from a short maturity around five years to a longer maturity around 30 years. The shorter maturity index varies from the rest of the indices. While the timing of yield changes coincides with all the other indices the level of those changes is different. During August 2008 yields only increase 20 percent above January 2006 levels, however, yields still shot up on the order of magnitude of 70 percent. This is a result of a sharp decrease in yields following June 2007. The five year index drops far below the other maturity indices by the end of December to a level approximately 80 percent of January 2006 levels. While the 70 percent jump in yields for the five year maturity index is in line with other indices when compared to the other maturity indices, it is small in comparison. The jumps range from 130 percent to almost 300 percent for longer maturity indices. The other maturity indices follow a similar pattern to that of the market, however, the twenty year and thirty year maturity indices have an index value at the end of the December 2009 that is on par with their January 2006 level. The ten year index has the more common drop in bond yields following January 2009 and is well below the index base value by January 2009.

The results so far have been expected, which is what is wanted from an index. An index should act as a measure of the market dynamics. A common trend through all the separate indices is they have the same overall pattern. I next look at table 4.70 to analyze the need for separate indices and judge whether or not they are redundant. The first column in table 4.70 shows the high correlation coefficients between the market wide municipal bond repeat sales index and the repeat sales indices for different characteristics. Over half of the indices have a greater than .9 correlation coefficient, suggesting that the market index is representative of the sub indices cre-
ated, if one is only interested in trends. It is important to remember that this paper is also interested in pricing, which can make having different indices more valuable. As I mentioned before the insured index and the revenue index are very similar, looking at how correlated they are shows a correlation coefficient of 1 when rounded to 2 decimal places. Also notice that the 10-year maturity index is highly correlated 1 and .99 with the insured index and revenue index. The high correlation between the three indices makes the need for all of them unnecessary. The high degree of correlation could shift if one looks over different time frames and for that reason it might be good to have them. But it is apparent that during this crisis the revenue bonds that were trading were insured bonds and the bonds in the 10 year index were insured as well. But not all the indices are highly correlated, if we look at the indices for the lowest rating groups, California, or maturity groups excluding the 10 year maturity then we notice different trends.

One interesting effect is that the 30 year maturity index has a .96 and .89 correlation coefficient with the $\mathrm{BBB}+$ index and A index, respectively. But the 30 year maturity index has a .19 correlation coefficient with AAA and AA, which suggests that during 2006-2009 the only long term bonds that were trading were the lower quality bonds. The correlation coefficients further highlight the difference between CA and NY indices and the need for state indices. California is highly correlated with the insured index but not with the uninsured while New York is highly correlated with the uninsured index and not with the insured index.

Analyzing the difference between the repeat sales indices reveals that for practical purpose one could limit the number of separate indices after creating a market wide index. Next, I analyze how the repeat sales index relates to the existing municipal bond indices. I obtain data from Bloomberg on S\&P, Moodys and The Bond Buyer indices. I look first at the S\&P indices because S\&P provides separate indices to look at different municipal characteristics. One point to mention is that like my indices the separate indices of $\mathrm{S} \& \mathrm{P}$ are also highly correlated amongst themselves. The reason the correlations between S\&P indices and the repeat sales indices are negative is because the repeat sales indices use bond yields, while S\&P uses bond prices and bond prices are negatively correlated with yields, so negative correlation is expected. What is not expected is the high degree of correlation that S\&P indices have with the repeat sales indices. The correlation coefficients seem to vary around .7 to .8 for most comparisons. This suggests that while the indices are not exactly the same they are both measuring the municipal bond market and not separate effects. The next question, which is not answered in this paper, would be which is the more accurate
index to use in pricing. I would argue the repeat sales index is more accurate due to the use of actual transactional data. In comparing the repeat sales indices to the S\&P indices one can see that the indices do not match based on the index type. So for the S\&P market index the highest correlation is with the AA or GO repeat sales index instead of being with the repeat sales market wide index. This mismatch is the general pattern, however, the repeat sales 5 year maturity index and the S\&P short term index have a -. 89 correlation coefficient and S\&P Junk is most highly correlated with the repeat sales BBB+ index with a correlation coefficient of -.89 . One possible reason for why the indices mismatch is the compositions and definitions of the indices are not exactly the same. While $\mathrm{S} \& \mathrm{P}$ has eligibility requirements based on bond size the repeat sales indices do not have such requirements.

The Bond buyer indices seem to have nothing in common with the repeat sales indices. The highest correlation of all three indices are with California, BBB+ and the long maturity repeat sales indices. The correlations can be seen in table 4.72. This suggests that the Bond Buyer is choosing predominantly California bonds. The Bond Buyer specifically points out that they are using bonds with a 20 year maturity so the 20 and 30 year maturity repeat sales indices should be more highly correlated. It is puzzling that the $\mathrm{BBB}+$ indices would be more highly correlated than the AA repeats sales index with the bond buyer indices, since they are supposed to be on average rated AA.

Moody's has municipal bond indices of their own that track municipal bonds of a certain rating and maturity. Three different moodys indices track 20 year bonds that are rated A, AA, and AAA, respectively. They also track bonds with a 10 year maturity and a AAA or AA rating, respectively. One Moody's index tracks 20 year bonds that were competitive offers. A competitive offer is where the municipality solicits bid from underwriters and chooses the lowest bid. The alternative is a negotiated underwriting where the municipality chooses an underwriter to work with closely to bring the bonds to market.

Most of the repeat sales indices are not highly correlated with Moodys indices given by the fact that the correlation coefficients are typically below .5. There are some indices that have a correlation coefficient above .8. When comparing the market wide, the GO, AAA and AA repeat sales indices with the AAA 10 year and AA 10 year Moody's indices the correlation coefficients are above .8. Also, the 20 year and 30 year maturity repeat sales indices are highly correlated with the the AAA 20 year and AA 20 year Moody's indices. This aligns with the fact that the average maturity in the Market wide, AAA, AA and GO indices is around 10 years while the average
maturity on the 20-year and 30 year repeat sales indices is around 20 and 30 years. This highlights the fact that many indices are not needed if trying to find a trend in the municipal bond market.

### 3.7 Conclusion

In conclusion this paper has proposed applying repeat sales methodology to the municipal bond market in order to create a municipal bond index for tracking the performance of the market and to assist in pricing. The current indices use estimated prices or survey prices while the repeat sales methodology is based off of actual transactions. I create 15 distinct repeat sales indices and compare them to themselves and to the existing municipal bond indices. I find that the repeats sales indices are highly correlated with each other suggesting the need for few indices to pick up trends in the municipal market, but slight differences, such that if the index is used for pricing it can be beneficial to have distinct indices. The current indices have a correlation coefficient with the repeat sales indices on the order of magnitude of .8. This suggest that the indices are indeed capturing the same market and that perhaps the difference in correlation can be explained by the actual transactions used in computing the repeat sales indices versus the estimated prices in the existing indices. I argue that the repeat sales indices provide an improvement over the existing indices and are more practical as they can be computed from transparent trade prices instead of from surveys or proprietary estimated prices.

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## Chapter 4

## Appendix

### 4.1 First chapter

## Table 4.1: List of Coefficients

| VARIABLE | Description |
| :---: | :---: |
| AA | Dummy variable $=1$ for a S\&P pure rating of AA |
| AA+ | Dummy variable $=1$ for a S\&P pure rating of AA+ |
| All dummy | Dummy variable $=1$ if the bond is issued by a homogenous municipality |
| Type dummy | Dummy variable $=1$ if the bond is a General Obligation |
| Offering dummy | Dummy variable $=1$ if the bond was issued using a Competitive offering |
| Callable dummy | Dummy variable $=1$ if the bond is callable |
| Log maturity | Natural log of the maturity of the bond |
| Log issuesize | Natural log of the dollar amount of the entire debt issue |
| Log bondsize | Natural $\log$ of the dollar amount of the bond issue |
| Log bondsizesq | Natural log of the dollar amount of the bond issue squared |
| Log issuesizesq | Natural log of the dollar amount of the entire debt issue squared |
| Log pop | Natural log of the population of the municipality |
| Logpopsq | Natural $\log$ of the population of the municipality squared |
| Total wages | Natural $\log$ of the total wages and salaries paid by the municipality the year prior to bond issue |
| Log Out Debt | Natural log of the outstanding debt of the municipality the year prior to bond issue |

Table 4.2: Descriptive Statistics

| Variable | Count | Mean | Sd |
| :--- | :---: | :---: | :---: |
| Maturity | 135,679 | 5.49 | 4.02 |
| Par Trade (in dollars) | 135,679 | 282,010 | $1,723,017$ |
| Spread | 135,679 | -.30 | .92 |
| Competitive Offering | 135,679 | .40 | .49 |
| Issue size (in millions of dollars) | 135,679 | 486 | 1480 |
| Bond size (in millions of dollars) | 134,705 | 187 | 1120 |
| Time outstanding | 135,679 | 3.72 | 2.68 |
| Insured | 135,679 | .57 | .49 |
| Homogeneous Municipality | 135,679 | .36 | .48 |

Table 4.3: Description of Municipalities by Mixed and Homogeneous Issuers

|  | All | Mixed | Only Insured | Only Uninsured |
| :--- | :---: | :---: | :---: | :---: |
| Bonds | 9,436 | 4,950 | 2,935 | 1,551 |
| Municipalities | 762 | 231 | 400 | 131 |
| Transactions | 135,679 | 86,232 | 30,449 | 18,998 |
| Bonds per municipality | 12.4 | 21.4 | 7.3 | 11.8 |
| Transaction per bond | 14.4 | 17.4 | 10.4 | 12.2 |
| Transaction per muni | 178.1 | 373.3 | 76.1 | 145.0 |

Table 4.4: Average difference between insured versus uninsured municipal bonds with controls and time fixed effects This table shows results from the ordinary least squares regression of the spread between municipal bond yields and treasury on an insured dummy, controls and time fixed effects

$$
\text { Spread }_{i}=\beta_{1} * \text { Insured }+\underline{\beta} * X_{i, k}+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i}
$$

where Spread $_{i}$ represents the spread to treasury for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond i , and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, $* *$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009. The sample is restricted to general obligation municipal bonds with an underlying AA rating from issuers with outstanding $\frac{\text { insured and uninsured debt. }}{\text { Full }}$
Pre Stock Drop

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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Insurance Benefit

## logmaturity

Size dummy
Time outstanding

## $\log ($ issue size $)$

$\log$ (bond size)
Offering dummy

## Constant

[^4]Full Sample
Table 4.5: Average difference between insured versus uninsured municipal bonds with issuer fixed effects, time fixed effects and controls
This table shows results from the ordinary least squares regression of the spread between municipal bond yields and treasury on an insured dummy
$$
\text { Spread }_{i}=\beta_{1} * \text { Insured }+\underline{\beta} * X_{i, k}+\beta_{\text {Issuer }} * \gamma_{\text {Issuer }}+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i}
$$
where $S_{\text {pread }}^{i}$ represents the spread to treasury for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond $i$, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, **, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006- May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009. The sample is restricted to general obligation municipal bonds with an underlying AA rating from issuers with outstanding insured and uninsured debt.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insurance benefit | -0.0836*** | -0.0796*** | -0.0925*** | -0.0787*** | -0.0814*** |
|  | (0.0235) | (0.0222) | (0.0245) | (0.0294) | (0.0255) |
| Log maturity | -0.0519*** | $0.320^{* * *}$ | $-0.101^{* * *}$ | $0.0753^{* *}$ | $-0.104^{* * *}$ |
|  | (0.0160) | (0.0322) | (0.0149) | (0.0298) | (0.0143) |
| Size dummy | $0.0794^{* * *}$ | 0.000666 | $0.116^{* * *}$ | $0.0119^{* * *}$ | $0.135^{* * *}$ |
|  | (0.00532) | (0.00366) | (0.00619) | (0.00449) | (0.0115) |
| Time outstanding | 0.00707 | 0.0274*** | $0.0458^{* * *}$ | 0.0175** | $0.0665^{* * *}$ |
|  | (0.0110) | (0.00712) | (0.0148) | (0.00837) | (0.0207) |
| Log issue size | 0.0123 | 0.00173 | 0.0163 | -0.000672 | 0.0160 |
|  | (0.0127) | (0.00958) | (0.0148) | (0.0106) | (0.0163) |
| Log bond size | $0.126^{* * *}$ | $0.0643^{* * *}$ | $0.134^{* * *}$ | 0.0784** | $0.144^{* * *}$ |
|  | (0.0242) | (0.0217) | (0.0227) | (0.0307) | (0.0205) |
| Offering dummy | 0.0373 * | 0.0132 | $0.0451 * *$ | 0.0177 | 0.0491** |
|  | (0.0192) | (0.0157) | (0.0216) | (0.0200) | (0.0233) |
| Constant | -3.011*** | $-2.463^{* * *}$ | $-2.468^{* * *}$ | $-2.211^{* * *}$ | $-3.586^{* * *}$ |
|  | (0.543) | (0.515) | (0.488) | (0.675) | (0.475) |
| Observations | 71,202 | 21,437 | 49,765 | 35,655 | 35,547 |
| R-squared | 0.880 | 0.651 | 0.827 | 0.846 | 0.798 |

Table 4.6: Average difference between AMBAC insured versus uninsured municipal bonds
This table shows results from the ordinary least squares regression of the spread between municipal bond yields and treasury on an insured dummy
where $S_{\text {pread }}^{i}$ represents the spread to treasury for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond $i$, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006- May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009. The sample is restricted to general obligation municipal bonds with an underlying AA rating from issuers with outstanding insured and uninsured debt.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insurance benefit | $\begin{gathered} -0.0798^{* *} \\ (0.0310) \end{gathered}$ | $\begin{gathered} -0.116^{* * *} \\ (0.0237) \end{gathered}$ | $\begin{gathered} -0.0828^{* *} \\ (0.0366) \end{gathered}$ | $\begin{gathered} -0.118^{* * *} \\ (0.0326) \end{gathered}$ | $\begin{aligned} & -0.0511 \\ & (0.0408) \end{aligned}$ |
| Log maturity | $\begin{aligned} & -0.0278 \\ & (0.0174) \end{aligned}$ | $\begin{gathered} 0.343^{* * *} \\ (0.0248) \end{gathered}$ | $\begin{gathered} -0.0664^{* * *} \\ (0.0191) \end{gathered}$ | $\begin{gathered} 0.111^{* * *} \\ (0.0225) \end{gathered}$ | $\begin{gathered} -0.0678^{* * *} \\ (0.0202) \end{gathered}$ |
| Size dummy | $\begin{gathered} 0.0596^{* * *} \\ (0.0109) \end{gathered}$ | $\begin{aligned} & -0.00898 \\ & (0.00602) \end{aligned}$ | $\begin{gathered} 0.0887^{* * *} \\ (0.0123) \end{gathered}$ | $\begin{gathered} 0.00669 \\ (0.00664) \end{gathered}$ | $\begin{gathered} 0.0909^{* * *} \\ (0.0217) \end{gathered}$ |
| Time outstanding | $\begin{aligned} & 0.00101 \\ & (0.0214) \end{aligned}$ | $\begin{gathered} 0.0401^{* * *} \\ (0.0153) \end{gathered}$ | $\begin{aligned} & 0.0512^{*} \\ & (0.0279) \end{aligned}$ | $\begin{gathered} 0.0253 \\ (0.0164) \end{gathered}$ | $\begin{gathered} 0.0889^{* *} \\ (0.0421) \end{gathered}$ |
| Log issue size | $\begin{gathered} 0.0233 \\ (0.0181) \end{gathered}$ | $\begin{aligned} & 0.00426 \\ & (0.0156) \end{aligned}$ | $\begin{gathered} 0.0290 \\ (0.0207) \end{gathered}$ | $\begin{aligned} & 0.00573 \\ & (0.0161) \end{aligned}$ | $\begin{gathered} 0.0227 \\ (0.0236) \end{gathered}$ |
| Log bond size | $\begin{aligned} & 0.141^{* * *} \\ & (0.0162) \end{aligned}$ | $\begin{gathered} 0.0861^{* * *} \\ (0.0166) \end{gathered}$ | $\begin{gathered} 0.141^{* * *} \\ (0.0156) \end{gathered}$ | $\begin{gathered} 0.103^{* * *} \\ (0.0222) \end{gathered}$ | $\begin{gathered} 0.148^{* * *} \\ (0.0160) \end{gathered}$ |
| Offering dummy | $\begin{gathered} 0.0611^{* *} \\ (0.0250) \end{gathered}$ | $\begin{aligned} & 0.0403^{*} \\ & (0.0230) \end{aligned}$ | $\begin{gathered} 0.0703^{* *} \\ (0.0285) \end{gathered}$ | $\begin{gathered} 0.0249 \\ (0.0245) \end{gathered}$ | $\begin{gathered} 0.0869^{* * *} \\ (0.0316) \end{gathered}$ |
| Constant | $\begin{gathered} -3.539^{* * *} \\ (0.401) \end{gathered}$ | $\begin{gathered} -2.933^{* * *} \\ (0.386) \end{gathered}$ | $\begin{gathered} -3.884^{* * *} \\ (0.395) \end{gathered}$ | $\begin{gathered} -2.793^{* * *} \\ (0.539) \end{gathered}$ | $\begin{gathered} -3.032^{* * *} \\ (0.405) \end{gathered}$ |
| Observations | 31,999 | 8,933 | 23,066 | 14,816 | 17,183 |
| R-squared | 0.884 | 0.758 | 0.837 | 0.830 | 0.817 |

Table 4.7: Average difference between Assured insured versus uninsured municipal bonds
This table shows results from the ordinary least squares regression of the spread between municipal bond yields and treasury on an insured dummy
where $\operatorname{Spread}_{i}$ represents the spread to treasury for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond $i$, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and $* * *$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006- May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009. The sample is restricted to general obligation municipal bonds with an underlying AA rating from issuers with outstanding insured and uninsured debt.
Post Downgrade
$-0.0524^{* *}$ - 0.192118 ) $0.132^{* * *}$
$(0.00875)$ $(0.00875)$
0.00400 (0.0241) -0.0203 $(0.0148)$
-0.00894 © ${ }^{2}+$ 0
0
0
0
0
0 $\stackrel{2}{2}$
12,790
0.841
$-0.0293^{* * *}$
$(0.00879)$
-0.0109 (0.0180) (0.00590) -0.00170
$(0.00831)$ -0.00669 -0.00198 $(0.00748)$
$-0.0279^{* * *}$ 20
0
0
0
0
0
0
0
0
0 (0.171) 12,948
0.876 *
$\stackrel{*}{*}$
曾
B
0
$i$ -0.0536
$(0.0151)$
$-0.189^{* * *}$ (0.0107) $0.106^{* * *}$ (0.00705)
-0.0154) $-0.0197^{*}$ $-0.00621$ (0.00860) 10
0
0
1
1 $(0.0128)$
$0.901^{* * *}$ (0.181)
0.00941 (0.00670) 0.00438 (0.0108) -0.00564
$(0.00730)$ $(0.00730)$
-0.0136 (0.0112) $\xrightarrow[\sim]{*}$ (0.201) 7,547
0.569 Full Sample
$-0.0365^{* * *}$ $-0.0365^{* * *}$
$(0.0122)$
$-0.139^{* * *}$ (0.0117) $0.0750^{* * *}$ (0.00605) $-0.0302^{* * *}$ (0.0117) (0.0103) $-0.00157$ $-0.0414^{* * *}$ (0.0116) $-0.266$ 25,738
0.900
Insurance benefit

## Log maturity

Size dummy
Time outstanding
Log issue size
Log bond size
Offering dummy
Observations

## Constant

R-squared
Table 4.8: Average difference between MBIA insured versus uninsured municipal bonds
This table shows results from the ordinary least squares regression of the spread between municipal bond yields and treasury on an insured dummy
where $S p r e a d ~_{i}$ represents the spread to treasury for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond $i$, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006- May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009. The sample is restricted to general obligation municipal bonds with an underlying AA rating from issuers with outstanding insured and uninsured debt.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insurance benefit | 0.00860 | -0.0201** | 0.00182 | -0.0110 | 0.00812 |
|  | (0.0125) | (0.00964) | (0.0148) | (0.0105) | (0.0178) |
| Log maturity | $-0.162^{* * *}$ | $0.225^{* * *}$ | -0.214*** | -0.0262 | -0.219*** |
|  | (0.0120) | (0.0243) | (0.0109) | (0.0194) | (0.0115) |
| Size dummy | 0.0711*** | 0.00372 | $0.106^{* * *}$ | 0.0220*** | $0.135^{* * *}$ |
|  | (0.00572) | (0.00454) | (0.00693) | (0.00576) | (0.00848) |
| Time outstanding | -0.00371 | 0.0220 *** | 0.0144 | 0.00783 | 0.0413** |
|  | (0.0104) | (0.00596) | (0.0138) | (0.00921) | (0.0180) |
| Log issue size | -0.0230** | -0.0198** | -0.00933 | -0.0197** | -0.0104 |
|  | (0.0108) | (0.0100) | (0.0118) | (0.00903) | (0.0155) |
| Log bond size | 0.00260 | 0.0131** | -0.0118 | $0.0187^{* * *}$ | -0.0253** |
|  | (0.00784) | (0.00595) | (0.00886) | (0.00707) | (0.0109) |
| Offering dummy | -0.0301** | -0.0214* | -0.0308* | -0.0152 | -0.0424** |
|  | (0.0149) | (0.0127) | (0.0169) | (0.0163) | (0.0186) |
| Constant | -0.283 | $-1.117^{* * *}$ | $0.703^{* * *}$ | $-0.799^{* * *}$ | -0.233 |
|  | (0.175) | (0.193) | (0.186) | (0.165) | (0.239) |
| Observations | 26,888 | 8,609 | 18,279 | 14,495 | 12,393 |
| R-squared | 0.887 | 0.432 | 0.832 | 0.878 | 0.793 |

Table 4.9: Self selection effect with time controls
This table shows results from the difference in difference regression below:
(4.1)
where $S p r e a d ~_{i, j}$ represents the spread to treasury for municipal bond i, issued by issuer j . All is 1 if issuer has all issues insured or uninsured, and $X_{i, j}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 - May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009. The sample is restricted to general obligation municipal bonds with an underlying AA rating.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| insuredpartial | $0.134^{* * *}$ | $0.0662^{* * *}$ | $0.183{ }^{* * *}$ | 0.0648** | 0.209*** |
|  | (0.0260) | (0.0231) | (0.0282) | (0.0305) | (0.0306) |
| insureddummy | $-0.0852^{* * *}$ | -0.0798*** | -0.0942*** | -0.0791*** | $-0.0827 * * *$ |
|  | (0.0239) | (0.0224) | (0.0249) | (0.0296) | (0.0256) |
| logmaturity | -0.0520*** | $0.320^{* * *}$ | $-0.102^{* * *}$ | $0.0777^{* * *}$ | $-0.105^{* * *}$ |
|  | (0.0157) | (0.0319) | (0.0146) | (0.0297) | (0.0140) |
| Size dummy | $0.0678^{* * *}$ | -0.00276 | $0.0994^{* * *}$ | 0.00716* | 0.118*** |
|  | (0.00426) | (0.00315) | (0.00503) | (0.00396) | (0.00915) |
| Time outstanding | 0.00333 | 0.0271*** | 0.0458*** | 0.0130 | 0.0662*** |
|  | (0.0107) | (0.00707) | (0.0145) | (0.00832) | (0.0198) |
| Log(issue size) | 0.0123 | 0.00158 | 0.0157 | -0.000513 | 0.0157 |
|  | (0.0128) | (0.00949) | (0.0148) | (0.0105) | (0.0164) |
| Log(bond size) | $0.125^{* * *}$ | 0.0637*** | $0.134^{* * *}$ | 0.0769** | $0.144^{* * *}$ |
|  | (0.0244) | (0.0216) | (0.0230) | (0.0306) | (0.0205) |
| Offering dummy | -0.0126 | 0.00357 | -0.0145 | -0.0105 | -0.0118 |
|  | (0.0126) | (0.00833) | (0.0149) | (0.0114) | (0.0167) |
| Constant | $-2.025^{* * *}$ | -1.971*** | -1.349*** | -1.650 *** | $-2.341^{* * *}$ |
|  | (0.355) | (0.323) | (0.326) | (0.425) | (0.313) |
| Observations | 109,419 | 33,781 | 75,638 | 55,829 | 53,590 |
| R-squared | 0.875 | 0.602 | 0.817 | 0.850 | 0.784 |

Table 4.10: Self selection effect with time controls for AMBAC insured bonds
This table shows results from the difference in difference regression below:

|  |  | $\begin{aligned} & =\beta_{1} * \text { Insure } \\ & +\quad \beta * X_{i, j} * A \end{aligned}$ | $\begin{aligned} & * \text { All } * \text { Insured }+ \\ & * \gamma_{s} * \text { All }+\beta_{s} * \gamma \end{aligned}$ | $\begin{aligned} & \text { All }+\underline{\beta} * X_{i, j} \\ & t * \gamma_{t}+\epsilon_{i, j} \end{aligned}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| where $\operatorname{Spread}_{i, j}$ represents the spread to treasury for municipal bond i , issued by issuer j . $A l l$ is 1 if issuer has all issues insured or uninsured, and $X_{i, j}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond i , Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, **, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009. The sample is restricted to general obligation municipal bonds with an underlying AA rating. |  |  |  |  |  |
|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| insuredpartial | 0.169*** | 0.124*** | 0.201*** | $0.134^{* * *}$ | 0.206*** |
|  | (0.0357) | (0.0429) | (0.0410) | (0.0421) | (0.0463) |
| insureddummy | $-0.0822^{* * *}$ | $-0.119^{* * *}$ | -0.0873** | $-0.118^{* * *}$ | -0.0557 |
|  | (0.0299) | (0.0398) | (0.0339) | (0.0372) | (0.0368) |
| Size dummy | $0.0480^{* * *}$ | -0.0109* | $0.0692^{* * *}$ | 0.00290 | $0.0726^{* * *}$ |
|  | (0.00826) | (0.00642) | (0.00911) | (0.00588) | (0.0173) |
| Time outstanding | 0.00887 | -0.0538** | $0.0787^{* * *}$ | -0.0178 | 0.116*** |
|  | (0.0196) | (0.0229) | (0.0267) | (0.0181) | (0.0388) |
| Log(issue size) | 0.0253 | -0.0183 | 0.0378* | -0.00108 | 0.0339 |
|  | (0.0179) | (0.0221) | (0.0204) | (0.0179) | (0.0232) |
| Log(bond size) | 0.133*** | 0.160*** | 0.119*** | 0.129*** | 0.124*** |
|  | (0.0176) | (0.0259) | (0.0172) | (0.0273) | (0.0176) |
| Offering dummy | 0.0311** | -0.0161 | 0.0496*** | -0.0125 | 0.0718*** |
|  | (0.0133) | (0.0171) | (0.0166) | (0.0136) | (0.0195) |
| Constant | $-2.423 * * *$ | $-2.194^{* * *}$ | -1.838*** | -1.958*** | -1.926*** |
|  | (0.255) | (0.345) | (0.230) | (0.376) | (0.246) |
| Observations | 49,038 | 15,005 | 34,033 | 24,302 | 24,736 |
| R-squared | 0.885 | 0.633 | 0.833 | 0.842 | 0.809 |

Table 4.11: Self selection effect with time controls for Assured insured bonds
This table shows results from the difference in difference regression below:

| $\begin{aligned} \text { Spread }_{i, j} & =\beta_{1} * \text { Insured }+\beta_{2} * \text { All } * \text { Insured }+\beta_{3} * \text { All }+\underline{\beta} * X_{i, j} \\ & +\beta * X_{i, j} * \text { All }+\beta_{s} * \gamma_{s} * \text { All }+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i, j} \end{aligned}$ |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| where $S p r e a d_{i, j}$ represents the spread to treasury for municipal bond i , issued by issuer j . $A l l$ is 1 if issuer has all issues insured or uninsured, and $X_{i, j}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond i , Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009. The sample is restricted to general obligation municipal bonds with an underlying AA rating. |  |  |  |  |  |
|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| insuredpartial | $0.0316^{*}$ | $-0.0134$ | $0.0754^{* * *}$ $(0.0248)$ | $0.00415$ | $0.0993^{* * *}$ |
| insureddummy | -0.0324** | -0.00945 | ${ }^{-0.0494 * * *}$ | $-0.0304^{* * *}$ | $-0.0458{ }^{*}$ |
| Size dummy | $\begin{gathered} (0.0132) \\ 0.0519^{* * *} \end{gathered}$ (0.00493) | $\begin{gathered} (0.0107) \\ 0.000544 \end{gathered}$ <br> (0.00490) | $\begin{gathered} (0.0185) \\ 0.0722^{* * *} \end{gathered}$ | (0.00884) <br> $0.0106^{* *}$ <br> (0.00465) | ${ }^{(0.0248)}$ <br> $0.0947^{* * *}$ |
| Time outstanding | $\begin{gathered} 0.0363^{* * *} \\ (0.0111) \end{gathered}$ | $\begin{gathered} -0.0363^{* * *} \\ (0.00944) \end{gathered}$ | $\begin{gathered} 0.0788^{* * *} \\ (0.0155) \end{gathered}$ | $\begin{gathered} 4.48 \mathrm{e}-05 \\ (0.00798) \end{gathered}$ | $\begin{gathered} 0.105^{* * *} \\ (0.0234) \end{gathered}$ |
| $\log$ (issue size) | $\begin{gathered} -0.0159 \\ (0.00989) \end{gathered}$ | $\begin{gathered} -0.00317 \\ (0.0129) \end{gathered}$ | $\begin{gathered} -0.0230^{*} \\ (0.0123) \end{gathered}$ | $\begin{aligned} & -0.00599 \\ & (0.00972) \end{aligned}$ | $\begin{aligned} & -0.0243 \\ & (0.0156) \end{aligned}$ |
| Log(bond size) | $\begin{gathered} -0.0167 * * \\ (0.00771) \end{gathered}$ | $\begin{gathered} 0.0150 \\ (0.00927) \end{gathered}$ | $\begin{gathered} -0.0290^{* * *} \\ (0.00976) \end{gathered}$ | $\begin{aligned} & -0.00403 \\ & (0.00767) \end{aligned}$ | $\begin{gathered} -0.0320^{* * *} \\ (0.0113) \end{gathered}$ |
| Offering dummy | $\begin{gathered} -0.0268^{* * *} \\ (0.00785) \end{gathered}$ | $\begin{aligned} & -0.00885 \\ & (0.00870) \end{aligned}$ | $\begin{gathered} -0.0323^{* * *} \\ (0.0110) \end{gathered}$ | $\begin{gathered} -0.0243^{* * *} \\ (0.00703) \end{gathered}$ | $\begin{gathered} -0.0234^{*} \\ (0.0137) \end{gathered}$ |
| Constant | $\begin{gathered} -0.422^{* * *} \\ (0.101) \end{gathered}$ | $\begin{gathered} -1.053^{* * *} \\ (0.120) \end{gathered}$ | $\begin{gathered} 0.874^{* * *} \\ (0.128) \end{gathered}$ | $\begin{gathered} -0.764^{* * *} \\ (0.0955) \end{gathered}$ | $\begin{gathered} 0.722^{* * *} \\ (0.160) \end{gathered}$ |
| Observations | 46,197 | 14,520 | 31,677 | 24,040 | 22,157 |
| R-squared | 0.891 | 0.483 | 0.841 | 0.877 | 0.815 |

Table 4.12: Self selection effect with time controls for MBIA insured bonds This table shows results from the difference in difference regression below:

|  | $S p r$ | $\begin{aligned} & =\beta_{1} * \text { Insure } \\ & +\quad \beta * X_{i, j} * A l \end{aligned}$ | $\begin{aligned} & * \text { All } * \text { Insured }+ \\ & * \gamma_{s} * \text { All }+\beta_{s} * \gamma \end{aligned}$ | $\begin{aligned} & l l+\underline{\beta} * X_{i, j} \\ & * \gamma_{t}+\epsilon_{i, j} \end{aligned}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| where $S p r e a d_{i, j}$ represents the spread to treasury for municipal bond i , issued by issuer j . All is 1 if issuer has all issues insured or uninsured, and $X_{i, j}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond i , Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, **, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009. The sample is restricted to general obligation municipal bonds with an underlying AA rating. |  |  |  |  |  |
|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| insuredpartial | $\begin{gathered} 0.0621^{* * *} \\ (0.0227) \end{gathered}$ | $\begin{gathered} -0.00469 \\ (0.0181) \end{gathered}$ | $\begin{gathered} 0.112^{* * *} \\ (0.0283) \end{gathered}$ | $0.00884$ (0.0211) | $\begin{gathered} 0.147^{* * *} \\ (0.0324) \end{gathered}$ |
| insureddummy | $\begin{gathered} 0.0134 \\ (0.0131) \end{gathered}$ | $\begin{aligned} & -0.0128 \\ & (0.0119) \end{aligned}$ | $\begin{aligned} & 0.00874 \\ & (0.0176) \end{aligned}$ | $\begin{aligned} & -0.0107 \\ & (0.0109) \end{aligned}$ | $\begin{gathered} 0.0132 \\ (0.0199) \end{gathered}$ |
| Size dummy | $\begin{gathered} 0.0487^{* * *} \\ (0.00514) \end{gathered}$ | $\begin{aligned} & -0.00710 \\ & (0.00437) \end{aligned}$ | $\begin{gathered} 0.0741^{* * *} \\ (0.00673) \end{gathered}$ | $\begin{aligned} & 0.0113^{* *} \\ & (0.00516) \end{aligned}$ | $\begin{aligned} & 0.0962^{* * *} \\ & (0.00787) \end{aligned}$ |
| Time outstanding | $\begin{gathered} 0.0669^{* * *} \\ (0.00970) \end{gathered}$ | $\begin{gathered} -0.0258^{* * *} \\ (0.00842) \end{gathered}$ | $\begin{aligned} & 0.123^{* * *} \\ & (0.0135) \end{aligned}$ | $\begin{gathered} 0.0139^{*} \\ (0.00817) \end{gathered}$ | $\begin{gathered} 0.177^{* * *} \\ (0.0178) \end{gathered}$ |
| $\log$ (issue size) | $\begin{gathered} -0.00619 \\ (0.0101) \end{gathered}$ | $\begin{gathered} -0.0381^{* * *} \\ (0.0111) \end{gathered}$ | $\begin{gathered} 0.0177 \\ (0.0127) \end{gathered}$ | $\begin{gathered} -0.0175^{* *} \\ (0.00829) \end{gathered}$ | $\begin{gathered} 0.0220 \\ (0.0169) \end{gathered}$ |
| Log(bond size) | $\begin{gathered} -0.0260^{* * *} \\ (0.00790) \end{gathered}$ | $\begin{aligned} & 0.0367 * * * \\ & (0.00848) \end{aligned}$ | $\begin{gathered} -0.0560^{* * *} \\ (0.00998) \end{gathered}$ | $\begin{gathered} 0.0142^{*} \\ (0.00735) \end{gathered}$ | $\begin{gathered} -0.0770^{* * *} \\ (0.0122) \end{gathered}$ |
| Offering dummy | $\begin{gathered} -0.0462^{* * *} \\ (0.0177) \end{gathered}$ | $\begin{aligned} & -0.0144^{*} \\ & (0.00828) \end{aligned}$ | $\begin{gathered} -0.0483^{* *} \\ (0.0225) \end{gathered}$ | $\begin{gathered} -0.0292^{* *} \\ (0.0126) \end{gathered}$ | $\begin{gathered} -0.0532^{* *} \\ (0.0254) \end{gathered}$ |
| Constant | $\begin{gathered} -0.280^{* *} \\ (0.117) \end{gathered}$ | $\begin{gathered} -0.802^{* * *} \\ (0.116) \end{gathered}$ | $\begin{gathered} 0.579^{* * *} \\ (0.146) \end{gathered}$ | $\begin{gathered} -0.714^{* * *} \\ (0.100) \end{gathered}$ | $\begin{gathered} -0.0716 \\ (0.185) \end{gathered}$ |
| Observations | 47,642 | 15,986 | 31,656 | 26,055 | 21,587 |
| R-squared | 0.870 | 0.375 | 0.801 | 0.865 | 0.757 |


1.1: The two vertical lines represent the dates of the stock prices drop and the first ratings downgrade of AMBAC IIA, respectively. This figure represents the Biased OLS average estimate of insurance.

1.2: The two vertical lines represent the dates of the stock prices drop and the first ratings downgrade of AMBAC

IA, respectively.

1.3: The two vertical lines represent the dates of the stock prices drop and the first ratings downgrade of AMBAC

IIA, respectively.

1.4: The two vertical lines represent the dates of the stock prices drop and the first ratings downgrade of AMBAC

IA, respectively.

1.5: The two vertical lines represent the dates of the stock prices drop and the first ratings downgrade of AMBAC IA, respectively.

1.6: The two vertical lines represent the dates of the stock prices drop and the first ratings downgrade of AMBAC IA, respectively.

1.7: The two vertical lines represent the dates of the stock prices drop and the first ratings downgrade of AMBAC IA, respectively.

1.8: The two vertical lines represent the dates of the stock prices drop and the first ratings downgrade of AMBAC

IA, respectively.

1.9: The two vertical lines represent the dates of the stock prices drop and the first ratings downgrade of AMBAC

IA, respectively.

Table 4.13: Differences between the two types of issuers with uninsured bonds This table shows results from the ordinary least squares regression of the spread between municipal bond yields and treasury on an issuer type dummy and controls

$$
\text { Spread }_{i}=\beta_{1} * \text { All }+\beta * X_{i, k}+\beta_{s} * \gamma_{s}+\epsilon_{i}
$$

where $S p r e a d i_{i}$ represents the spread to treasury for municipal bond i, All is one if bond i is issued by an issuer with only uninsured outstanding bonds and zero otherwise, $\gamma_{s}$ is a set of state controls, $X_{i, k}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond i , and $\epsilon_{i}$ is an error term. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 includes standard controls. Specification 2 includes time fixed effects. The sample is restricted to general obligation municipal bonds with an underlying AA rating from 2006-2009.

|  | No Time Fixed Effects | Time Fixed Effects |
| :--- | :---: | :---: |
| alldummy | -0.0160 | 0.0164 |
|  | $(0.0410)$ | $(0.0127)$ |
| logmaturity | $-0.210^{* * *}$ | $-0.0385^{* *}$ |
|  | $(0.0380)$ | $(0.0177)$ |
| Size dummy | $0.0789^{* * *}$ | $0.0867^{* * *}$ |
|  | $(0.0213)$ | $(0.00673)$ |
| Time outstanding | $0.414^{* * *}$ | $0.0372^{* * *}$ |
|  | $(0.0305)$ | $(0.0123)$ |
| Log(issue size) | $-0.0821^{* * *}$ | $-0.0531^{* * *}$ |
|  | $(0.0221)$ | $(0.0114)$ |
| Log(bond size) | $0.190^{* * *}$ | $0.131^{* * *}$ |
|  | $(0.0274)$ | $(0.0243)$ |
| Offering dummy | $0.121^{* * *}$ | $0.0667^{* * *}$ |
| Constant | $(0.0361)$ | $(0.0225)$ |
|  | $-1.870^{* * *}$ | $-1.785^{* * *}$ |
| Observations | $(0.324)$ | $(0.257)$ |
| R-squared |  |  |

### 4.2 Second chapter

Table 4.14: Differences between the two types of issuers with insured bonds This table shows results from the ordinary least squares regression of the spread between municipal bond yields and treasury on an issuer type dummy and controls

$$
\text { Spread }_{i}=\beta_{1} * \text { All }+\beta * X_{i, k}+\beta_{s} * \gamma_{s}+\epsilon_{i}
$$

where Spread $_{i}$ represents the spread to treasury for municipal bond i, All is one if bond i is issued by an issuer with only insured outstanding bonds and zero otherwise, $\gamma_{s}$ is a set of state controls, $X_{i, k}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond i , and $\epsilon_{i}$ is an error term. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 includes standard controls. Specification 2 includes time fixed effects. The sample is restricted to general obligation municipal bonds with an underlying AA rating from 2006-2009.

|  | No time Fixed Effects | Time Fixed Effects |
| :--- | :---: | :---: |
| alldummy | 0.0799 | -0.0373 |
|  | $(0.0708)$ | $(0.0458)$ |
| logmaturity | $-0.231^{* * *}$ | $-0.0649^{*}$ |
|  | $(0.0555)$ | $(0.0342)$ |
| Size dummy | $0.0996^{* * *}$ | $0.0851^{* * *}$ |
|  | $(0.0179)$ | $(0.00814)$ |
| Time outstanding | $0.508^{* * *}$ | 0.000224 |
| Log(issue size) | $(0.0430)$ | $(0.0119)$ |
| Log(bond size) | $-0.0820^{* * *}$ | -0.0113 |
|  | $(0.0243)$ | $(0.00932)$ |
| Offering dummy | $0.0553^{* *}$ | -0.00582 |
|  | $(0.0238)$ | $(0.00901)$ |
| Constant | -0.132 | $-0.169^{* *}$ |
|  | $(0.104)$ | $(0.0672)$ |
|  | 0.120 | $-0.448^{* * *}$ |
| Observations | $(0.235)$ | $(0.104)$ |
| R-squared | 66,133 | 66,133 |

Table 4.15: Likelihood of a bond being insured
This table shows results from the logistical regression of an insured dummy on bond characteristics and municipal characteristics

$$
\begin{equation*}
\text { Insured }_{i}=\beta_{1} * A A_{i}+\beta_{2} * A A+{ }_{i}+\underline{\beta} * X_{i, k}+\underline{\beta}_{s} * \gamma_{s}+\underline{\beta}_{c} * \gamma_{c}+\epsilon_{i} \tag{4.5}
\end{equation*}
$$

where Insured $_{i}$ is one if bond i is insured and 0 otherwise, AA is 1 if bond i has an underlying rating of AA and 0 otherwise, $\mathrm{AA}+$ is 1 if bond i has an underlying rating of $\mathrm{AA}+$ and 0 otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{c}$ is a set of census controls, $X_{i, k}$ is a vector of k standard controls used to estimate municipal bond spreads to treasury for bond i , and $\epsilon_{i}$ is an error term. Standard errors clustered by issuer are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 includes all bond. Specification 2 includes bonds with AA-, AA, and AA+ underlying rating. The sample is restricted to general obligation municipal bonds with an underlying AA rating from 2006-2009.

| VARIABLES | All | AA |
| :---: | :---: | :---: |
| AA | -2.164*** | -1.974*** |
|  | (0.370) | (0.453) |
| AA+ | -4.320*** | -3.970*** |
|  | (0.539) | (0.567) |
| General Obligation | -1.335 | -1.359*** |
|  | (1.076) | (0.462) |
| Competitive Offering | 0.849** | 0.615 |
|  | (0.396) | (0.472) |
| Callable | -0.776*** | -0.747** |
|  | (0.267) | (0.313) |
| Log Maturity | 8.255*** | 7.950*** |
|  | (1.512) | (1.799) |
| Log Issuesize | 10.06*** | 9.878*** |
|  | (1.911) | (2.520) |
| Log Bondsize | -0.389 | -1.289 |
|  | (1.090) | (1.553) |
| Log Bondsizesq | 0.008 | 0.040 |
|  | (0.036) | (0.051) |
| Log Issuesize squared | -0.278*** | -0.278*** |
|  | (0.056) | (0.072) |
| Log Population | 1.599** | -0.215 |
|  | (0.695) | (1.141) |
| Log Popoulation squared | -0.088*** | -0.008 |
|  | (0.027) | (0.045) |
| Log Interest on Debt per Capita | -0.723 | -0.623 |
|  | (0.483) | (0.538) |
| Log Debt Issued per Capita | -0.152 | -0.326 |
|  | (0.197) | (0.218) |
| Log Property Tax per Capita | $-0.320 * *$ | -0.144 |
|  | (0.139) | (0.165) |
| Constant | -171.2*** | -148.7*** |
|  | (21.64) | (27.42) |
| Observations | 10,021 | 6,204 |

Table 4.16: List of Controls

| VARIABLE | Description |
| :---: | :---: |
| AAA | Dummy variable $=1$ for a S\&P pure rating of AAA |
| AA | Dummy variable $=1$ for a S\&P pure rating of AA + , AA, and AA- |
| A | Dummy variable $=1$ for a S\&P pure rating of $\mathrm{A}+, \mathrm{A}$, and $\mathrm{A}-$ |
| BBB + | Dummy variable $=1$ for a S\&P pure rating of BBB+ |
| Insured dummy | Dummy variable $=1$ if the bond is Insured |
| Size dummy | Dummy variable $=1$ if the trade size is greater than 100,000 dollars |
| Time outstanding | The number of years since the bond was issued |
| State dummies | Dummy variable $=1$ if bond is issued in the state |
| Time dummies | Dummy variable $=1$ if bond traded during the month |
| Type dummy | Dummy variable $=1$ if the bond is a General Obligation |
| Offering dummy | Dummy variable $=1$ if the bond was issued using a Competitive offering |
| Log maturity | Natural log of the maturity of the bond |
| Log issuesize | Natural log of the dollar amount of the entire debt issue |
| Log bondsize | Natural log of the dollar amount of the bond issue |

Table 4.17: Descriptive Statistics by Trade for Amihud Measure

| Variable | Count | Mean | SD |
| :--- | :---: | :---: | :---: |
| Maturity | 923,006 | 15.4 | 8.3 |
| Coupon | 916,509 | 4.45 | 1.02 |
| Par Trade (in dollars) | 923,006 | 348,852 | $6,341,587$ |
| Issue size (in millions of dollars) | 922,858 | 279 | 668 |
| Bond size (in millions of dollars) | 899,220 | 27 | 86 |

Table 4.18: Descriptive Statistics by Trade for Bid-Ask Measure

| Variable | Count | Mean | SD |
| :--- | :---: | :---: | :---: |
| Maturity | 209,195 | 18.1 | 8.3 |
| Coupon | 208,329 | 4.55 | 0.99 |
| Par Trade (in dollars) | 209,195 | 406,507 | $2,152,288$ |
| Issue size (in millions of dollars) | 209,181 | 370 | 865 |
| Bond size (in millions of dollars) | 201,548 | 46 | 143 |

Table 4.19: Descriptive Statistics by Trade for Turnover Measure

| Variable | Count | Mean | SD |
| :--- | :---: | :---: | :---: |
| Maturity | $2,250,147$ | 14.0 | 8.0 |
| Coupon | $2,240,441$ | 4.41 | 0.98 |
| Par Trade (in dollars) | $2,250,147$ | 337,352 | $4,375,890$ |
| Issue size (in millions of dollars) | $2,249,707$ | 230 | 572 |
| Bond size (in millions of dollars) | $2,203,609$ | 19 | 63 |

Table 4.20: Descriptive Statistics by Bond for Amihud Measure

| Variable | Count | Mean | SD |
| :--- | :---: | :---: | :---: |
| Maturity | 147,838 | 11.2 | 6.7 |
| Coupon | 14,441 | 4.19 | 1.05 |
| Par Trade (in dollars) | 147,838 | 709,485 | $3,305,479$ |
| Issue size (in millions of dollars) | 147,812 | 105 | 460 |
| Bond size (in millions of dollars) | 146,743 | 5 | 22 |

Table 4.21: Descriptive Statistics by Bond for Bid-Ask Measure

| Variable | Count | Mean | SD |
| :--- | :---: | :---: | :---: |
| Maturity | 60,797 | 12.8 | 7.4 |
| Coupon | 60,655 | 4.32 | 1.03 |
| Par Trade (in dollars) | 60,797 | 739,307 | $2,971,791$ |
| Issue size (in millions of dollars) | 60,789 | 165 | 512 |
| Bond size (in millions of dollars) | 60,022 | 9 | 31 |

Table 4.22: Descriptive Statistics by Bond for Turnover Measure

| Variable | Count | Mean | SD |
| :--- | :---: | :---: | :---: |
| Maturity | 212,042 | 10.9 | 6.6 |
| Coupon | 211,426 | 4.14 | 1.08 |
| Par Trade (in dollars) | 212,042 | 987,395 | $3,830,521$ |
| Issue size (in millions of dollars) | 211,968 | 82 | 400 |
| Bond size (in millions of dollars) | 210,819 | 4 | 18 |


|  | Table 4.23: Pure Ratings Distribution by Time Period for Amihud Measure |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Variable | Full Sample | Pre stock drop | Post stock drop | Pre downgrade | Post downgrade |
| AAA | 17.62 | 17.29 | 17.7 | 17.52 | 17.68 |
| AA | 45.72 | 42.52 | 46.52 | 42.89 | 47.67 |
| A | 32.2 | 34.64 | 31.72 | 34.17 | 31.02 |
| BBB+ | 1.94 | 2.47 | 1.81 | 2.32 | 1.68 |
| Insured | 53.52 | 70.64 | 49.21 | 66.75 | 44.38 |
| Total | 923,006 | 185,872 | 737,134 | 377,190 | 545,816 |


|  | Table 4.24: Pure Ratings Distribution by Time Period for Bid-Ask Measure |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Variable | Full Sample | Pre stock drop | Post stock drop | Pre downgrade | Post downgrade |
| AAA | 15.76 | 15.29 | 15.87 | 15.56 | 15.9 |
| AA | 45.45 | 43.73 | 45.84 | 43.53 | 46.76 |
| A | 34.45 | 35.02 | 34.32 | 35.21 | 33.95 |
| BBB+ | 1.96 | 2.58 | 1.82 | 2.38 | 1.68 |
| Insured | 50.06 | 70.66 | 45.45 | 65.17 | 39.81 |
| Total | 209,195 | 38,291 | 170,904 | 84,574 | 124,621 |


|  | Table 4.25: Pure Ratings Distribution by Time Period for Turnover Measure |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Variable | Full Sample | Pre stock drop | Post stock drop | Pre downgrade | Post downgrade |
| AAA | 17.65 | 17.90 | 17.59 | 17.97 | 17.43 |
| AA | 45.53 | 41.73 | 46.53 | 42.09 | 47.95 |
| A | 32.28 | 34.58 | 31.68 | 34.38 | 30.81 |
| BBB+ | 1.99 | 2.59 | 1.83 | 2.43 | 1.68 |
| Insured | 56.36 | 70.93 | 52.5 | 68.19 | 48.00 |
| Total | $2,250,147$ | 470,862 | $1,779,285$ | 932,166 | $1,317,981$ |

\[

\]

|  | Table 4.27: Actual Ratings Distribution by Time Period for Bid-Ask Measure |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Variable | Full Sample | Pre stock drop | Post stock drop | Pre downgrade | Post downgrade |
| AAA | 38.31 | 45.53 | 36.69 | 47.69 | 31.94 |
| AA | 36.72 | 29.88 | 38.25 | 28.55 | 42.27 |
| A | 25.22 | 20.75 | 22.43 | 20.3 | 23.37 |
| BBB+ | 1.27 | 1.49 | 1.22 | 1.42 | 1.16 |
| Insured | 50.06 | 70.66 | 45.45 | 65.17 | 39.81 |
| Total Bonds | 209,195 | 38,291 | 170,904 | 84,574 | 124,621 |


|  | Table 4.28: Actual Ratings Distribution by Time Period for Turnover Measure |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Variable | Full Sample | Pre stock drop | Post stock drop | Pre downgrade | Post downgrade |
| AAA | 45.49 | 59.36 | 41.82 | 60.75 | 34.70 |
| AA | 34.94 | 22.65 | 38.2 | 22.36 | 43.84 |
| A | 16.94 | 14.81 | 17.51 | 14.09 | 18.96 |
| BBB+ | 1.05 | 1.31 | 0.99 | 1.10 | 1.02 |
| Insured | 56.36 | 70.93 | 52.5 | 68.19 | 48.00 |
| Total Bonds | $2,250,147$ | 470,862 | $1,779,285$ | 932,166 | $1,317,981$ |

Table 4.29: Average difference in Amihud measure between insured and uninsured municipal bonds with controls and time fixed effects
This table shows results from the ordinary least squares regression of the Amihud measure on an insured dummy, controls and time fixed effects
where Amihud $_{i}$ represents the Amihud liquidity measure for municipal bond i, Insured is one if bond is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls including the pure rating, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009. Pre Stock Drop Post Stock Drop Pre Downgrade Post Downgrade $1.31 \mathrm{e}-08$
$(9.20 \mathrm{e}-09)$
$1.13 \mathrm{e}-07^{* * *}$
$(3.53 \mathrm{e}-09)$
$3.48 \mathrm{e}-07^{* * *}$
$(3.56 \mathrm{e}-09)$
$7.32 \mathrm{e}-08^{* * *}$
$(3.47 \mathrm{e}-09)$
$-3.32 \mathrm{e}-08^{* * *}$
$(3.60 \mathrm{e}-09)$
$5.37 \mathrm{e}-08^{* * *}$
$(3.87 \mathrm{e}-09)$
$-1.70 \mathrm{e}-08^{* *}$
$(7.10 \mathrm{e}-09)$
$-5.54 \mathrm{e}-07^{* * *}$
$(5.23 \mathrm{e}-08))$

270,147
0.101 $2.17 \mathrm{e}-08^{* * *}$
$(5.73 \mathrm{e}-09)$
$5.84 \mathrm{e}-08^{* * *}$
$(3.03 \mathrm{e}-09)$
$2.23 \mathrm{e}-07^{* * *}$
$(3.43 \mathrm{e}-09)$
$8.28 \mathrm{e}-08^{* * *}$
$(5.46 \mathrm{e}-09)$
$-5.63 \mathrm{e}-09$
$(4.97 \mathrm{e}-09)$
$1.71 \mathrm{e}-08^{* * *}$
$(4.70 \mathrm{e}-09)$
$-1.88 \mathrm{e}-09$
$(4.22 \mathrm{e}-09)$
$-2.97 \mathrm{e}-07^{* * *}$
$(3.99 \mathrm{e}-08)$ 119,339
0.073 $1.36 \mathrm{e}-08^{* *}$ $1.90 \mathrm{e}-08^{* *}$ $1.90 \mathrm{e}-08$
$(7.55 \mathrm{e}-09)$
$1.06 \mathrm{e}-07^{* * *}$ (3.11e-09) $3.25 \mathrm{e}-07^{* * *}$
$(3.04 \mathrm{e}-09)$ 7.40e-08*** -2.62e-08*** (3.40e-09) 4.46e-08***
$(3.60 \mathrm{e}-09)$ $-1.24 \mathrm{e}-08^{* *}$ $-4.91 \mathrm{e}-07^{* * *}$ (4.43e-08)
341,261
0.098
Full Sample
$1.87 \mathrm{e}-08^{* * *}$ $1.87 \mathrm{e}-08^{* * *}$
$(6.66 \mathrm{e}-09)$ $1.02 \mathrm{e}-07^{* * *}$ (2.90e-09) $3.08 \mathrm{e}-07^{* * *}$
$(2.81 \mathrm{e}-09)$ $7.63 \mathrm{e}-08^{* * *}$ (3.04e-09) -2.37e-08 (3.25e-09) $(3.35 \mathrm{e}-09)$ (5.14e-09) $-4.86 \mathrm{e}-07^{* * *}$ 389,486
0.102
Insurance effect
$\log$ (maturity) $\qquad$
Size dummy
Time outstanding
$\log$ (issue size)
$\log$ (bond size)
Offering dummy
Constant
Observations
R-squared
Table 4.30: Average difference in Amihud measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls
This table shows results from the ordinary least squares regression of the Amihud measure on an insured dummy
where Amihud $_{i}$ represents the Amihud measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insurance effect | $\begin{gathered} 6.10 \mathrm{e}-08^{* * *} \\ (8.26 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 1.41 \mathrm{e}-08 \\ (8.99 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 6.59 \mathrm{e}-08^{* * *} \\ (9.27 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 3.93 \mathrm{e}-08^{* * *} \\ (9.49 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 7.00 \mathrm{e}-08^{* * *} \\ (1.13 \mathrm{e}-08) \end{gathered}$ |
| Log(maturity) | $\begin{gathered} 8.14 \mathrm{e}-08^{* * *} \\ (2.41 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 4.50 \mathrm{e}-08^{* * *} \\ (3.72 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 8.40 \mathrm{e}-08^{* * *} \\ (2.61 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 5.30 \mathrm{e}-08^{* * *} \\ (3.83 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 8.55 \mathrm{e}-08^{* * *} \\ (2.91 \mathrm{e}-09) \end{gathered}$ |
| Size dummy | $\begin{gathered} 2.86 \mathrm{e}-07^{* * *} \\ (2.37 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 1.73 \mathrm{e}-07^{* * *} \\ (3.91 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 3.02 \mathrm{e}-07^{* * *} \\ (2.55 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 2.10 \mathrm{e}-07^{* * *} \\ (2.96 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 3.23 \mathrm{e}-07^{* * *} \\ (2.99 \mathrm{e}-09) \end{gathered}$ |
| Time outstanding | $\begin{gathered} 6.38 \mathrm{e}-08^{* * *} \\ (2.95 \mathrm{e}-09) \end{gathered}$ | $\begin{aligned} & 9.37 \mathrm{e}-08^{* * *} \\ & (1.62 \mathrm{e}-08) \end{aligned}$ | $\begin{gathered} 6.06 \mathrm{e}-08^{* * *} \\ (3.16 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 7.42 \mathrm{e}-08^{* * *} \\ (5.87 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 5.50 \mathrm{e}-08^{* * *} \\ (3.64 \mathrm{e}-09) \end{gathered}$ |
| Log(issue size) | $\begin{gathered} -1.74 \mathrm{e}-08^{* * *} \\ (5.14 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} -1.32 \mathrm{e}-08 \\ (1.15 \mathrm{e}-08) \end{gathered}$ | $\begin{gathered} -1.85 \mathrm{e}-08^{* * *} \\ (5.23 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} -4.18 \mathrm{e}-09 \\ (9.02 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} -2.22 \mathrm{e}-08^{* * *} \\ (5.55 \mathrm{e}-09) \end{gathered}$ |
| Log(bond size) | $\begin{gathered} 4.10 \mathrm{e}-08^{* * *} \\ (2.83 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 1.24 \mathrm{e}-08^{* * *} * \\ (3.40 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 4.38 \mathrm{e}-08^{* * *} \\ (3.09 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 8.84 \mathrm{e}-09 \\ (5.45 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 5.43 \mathrm{e}-08^{* * *} \\ (3.31 \mathrm{e}-09) \end{gathered}$ |
| Offering dummy | $\begin{aligned} & 2.17 \mathrm{e}-08^{* *} \\ & (8.52 \mathrm{e}-09) \end{aligned}$ | $\begin{aligned} & 3.82 \mathrm{e}-08^{* *} \\ & (1.57 \mathrm{e}-08) \end{aligned}$ | $\begin{gathered} 2.46 \mathrm{e}-08^{* * *} \\ (9.47 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} -3.66 \mathrm{e}-09 \\ (9.89 \mathrm{e}-09) \end{gathered}$ | $\begin{gathered} 3.28 \mathrm{e}-08^{* * *} \\ (1.13 \mathrm{e}-08) \end{gathered}$ |
| Constant | $\begin{gathered} -5.57 \mathrm{e}-07^{* * *} \\ (8.79 \mathrm{e}-08) \end{gathered}$ | $\begin{gathered} -8.66 \mathrm{e}-08 \\ (1.84 \mathrm{e}-07) \end{gathered}$ | $\begin{gathered} -6.13 \mathrm{e}-07^{* * *} \\ (8.84 \mathrm{e}-08) \end{gathered}$ | $\begin{aligned} & -2.06 \mathrm{e}-07^{*} \\ & (1.20 \mathrm{e}-07) \end{aligned}$ | $\begin{gathered} -6.91 \mathrm{e}-07^{* * *} \\ (1.00 \mathrm{e}-07) \end{gathered}$ |
| Observations | 389,486 | 48,225 | 341,261 | 119,339 | 270,147 |
| R-squared | 0.135 | 0.229 | 0.137 | 0.114 | 0.148 |

Table 4.31: Average difference in Amihud measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects, underlying rating dummies and controls
This table shows results from the ordinary least squares regression of the Amihud measure on an insured dummy
Amihud $_{i}=\beta_{1} *$ Insured $+\beta_{2} * A A_{i}+\beta_{3} * A_{i}+\beta_{4} * B B B+{ }_{i}+\underline{\beta} * X_{i, k}$
$+\beta_{\text {Issuer }} * \gamma_{\text {Issuer }}+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i}$
where $A$ mihud $_{i}$ represents the Amihud measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $A A_{i}$ is one if bond i is AA-rated and zero otherwise, $A_{i}$ is one if bond i is A-rated and zero otherwise, $B B B+{ }_{i}$ is one if bond i is $\mathrm{BBB}+$-rated and zero otherwise. $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, **, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time
period after the insurer downgrade from June 2008 to December 2009. period after the insurer downgrade from June 2008 to December 2009.

Table 4.32: The average effect of each insurer on liquidity as measured by the Amihud measure
This table shows results from the ordinary least squares regression of the Amihud measure on an dummy for each insurer
where Amihud $_{i}$ represents the Amihud measure for municipal bond i , Ambac is one if bond i is insured by Ambac and zero otherwise, Assured is one if bond i is insured by Assured and zero otherwise, MBIA is one if bond i is insured by MBIA and zero otherwise, $\gamma_{\text {Issuer }}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard controls including underlying rating controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. *, **, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Ambac effect | $5.22 \mathrm{e}-08^{* * *}$ | $1.52 \mathrm{e}-08$ | $5.16 \mathrm{e}-08^{* * *}$ | $3.82 \mathrm{e}-08^{* * *}$ | $5.47 \mathrm{e}-08^{* * *}$ |
|  | $(1.37 \mathrm{e}-08)$ | $(1.55 \mathrm{e}-08)$ | $(1.49 \mathrm{e}-08)$ | $(1.14 \mathrm{e}-08)$ | $(1.83 \mathrm{e}-08)$ |
| MBIA effect | $5.82 \mathrm{e}-08^{* * *}$ | $2.85 \mathrm{e}-09$ | $6.36 \mathrm{e}-08^{* * *}$ | $4.94 \mathrm{e}-08^{* * *}$ | $5.63 \mathrm{e}-08^{* * *}$ |
|  | $(1.36 \mathrm{e}-08)$ | $(1.99 \mathrm{e}-08)$ | $(1.50 \mathrm{e}-08)$ | $(1.23 \mathrm{e}-08)$ | $(1.85 \mathrm{e}-08)$ |
| Assured effect | $5.31 \mathrm{e}-08^{* * *}$ | $6.70 \mathrm{e}-09$ | $5.42 \mathrm{e}-08^{* * *}$ | $2.43 \mathrm{e}-08^{* * *}$ | $5.87 \mathrm{e}-08^{* * *}$ |
|  | $(9.17 \mathrm{e}-09)$ | $(1.12 \mathrm{e}-08)$ | $(1.02 \mathrm{e}-08)$ | $(8.41 \mathrm{e}-09)$ | $(1.23 \mathrm{e}-08)$ |
| Log(maturity) | $8.52 \mathrm{e}-08^{* * *}$ | $4.17 \mathrm{e}-08^{* * *}$ | $8.88 \mathrm{e}-08^{* * *}$ | $5.58 \mathrm{e}-08^{* * *}$ | $9.04 \mathrm{e}-08^{* * *}$ |
|  | $(2.36 \mathrm{e}-09)$ | $(3.29 \mathrm{e}-09)$ | $(2.57 \mathrm{e}-09)$ | $(3.34 \mathrm{e}-09)$ | $(2.85 \mathrm{e}-09)$ |
| Size dummy | $2.86 \mathrm{e}-07^{* * *}$ | $1.70 \mathrm{e}-07^{* * *}$ | $3.05 \mathrm{e}-07^{* * *}$ | $2.10 \mathrm{e}-07^{* * *}$ | $3.28 \mathrm{e}-07^{* * *}$ |
|  | $(2.19 \mathrm{e}-09)$ | $(3.33 \mathrm{e}-09)$ | $(2.38 \mathrm{e}-09)$ | $(2.60 \mathrm{e}-09)$ | $(2.85 \mathrm{e}-09)$ |
| Time outstanding | $5.91 \mathrm{e}-08^{* * *}$ | $9.83 \mathrm{e}-08^{* * *}$ | $5.58 \mathrm{e}-08^{* * *}$ | $7.29 \mathrm{e}-08^{* * *}$ | $5.04 \mathrm{e}-08^{* * *}$ |
|  | $(3.39 \mathrm{e}-09)$ | $(1.49 \mathrm{e}-08)$ | $(3.67 \mathrm{e}-09)$ | $(5.32 \mathrm{e}-09)$ | $(4.32 \mathrm{e}-09)$ |
| Log(issue size) | $-2.44 \mathrm{e}-08^{* * *}$ | $-2.60 \mathrm{e}-08^{* *}$ | $-2.47 \mathrm{e}-08^{* * *}$ | $-1.81 \mathrm{e}-08^{* *}$ | $-2.80 \mathrm{e}-08^{* * *}$ |
|  | $(5.30 \mathrm{e}-09)$ | $(1.26 \mathrm{e}-08)$ | $(5.37 \mathrm{e}-09)$ | $(8.73 \mathrm{e}-09)$ | $(5.83 \mathrm{e}-09)$ |
| Log(bond size) | $4.08 \mathrm{e}-08^{* * *}$ | $1.63 \mathrm{e}-08^{* * *}$ | $4.30 \mathrm{e}-08^{* * *}$ | $1.26 \mathrm{e}-08^{* * *}$ | $5.37 \mathrm{e}-08^{* * *}$ |
|  | $(2.67 \mathrm{e}-09)$ | $(3.22 \mathrm{e}-09)$ | $(2.94 \mathrm{e}-09)$ | $(4.65 \mathrm{e}-09)$ | $(3.17 \mathrm{e}-09)$ |
| Constant | $-4.44 \mathrm{e}-07^{* * *}$ | $6.57 \mathrm{e}-08$ | $-4.86 \mathrm{e}-07^{* * *}$ | $-4.58 \mathrm{e}-08$ | $-4.27 \mathrm{e}-07^{* * *}$ |
|  | $(8.93 \mathrm{e}-08)$ | $(2.01 \mathrm{e}-07)$ | $(9.11 \mathrm{e}-08)$ | $(1.25 \mathrm{e}-07)$ | $(1.05 \mathrm{e}-07)$ |
| Observations | 447,135 | 61,776 | 385,359 | 147,955 | 299,180 |
| R-squared | 0.132 | 0.211 | 0.133 | 0.114 | 0.143 |

Table 4.33: Average difference in Amihud measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bonds with a AA pure rating
This table shows results from the ordinary least squares regression of the Amihud measure on an insured dummy
where Amihud $_{i}$ represents the Amihud measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |
| Insurance effect | $4.38 \mathrm{e}-08^{* * *}$ | $-8.47 \mathrm{e}-10$ | $4.94 \mathrm{e}-08^{* * *}$ | $2.12 \mathrm{e}-08$ | $5.13 \mathrm{e}-08^{* * *}$ |
|  | $(1.01 \mathrm{e}-08)$ | $(1.18 \mathrm{e}-08)$ | $(1.14 \mathrm{e}-08)$ | $(1.32 \mathrm{e}-08)$ | $(1.34 \mathrm{e}-08)$ |
| Log(maturity) | $7.73 \mathrm{e}-08^{* * *}$ | $4.79 \mathrm{e}-08^{* * *}$ | $7.92 \mathrm{e}-08^{* * *}$ | $5.71 \mathrm{e}-08^{* * *}$ | $7.82 \mathrm{e}-08^{* * *}$ |
|  | $(3.17 \mathrm{e}-09)$ | $(5.66 \mathrm{e}-09)$ | $(3.41 \mathrm{e}-09)$ | $(6.61 \mathrm{e}-09)$ | $(3.67 \mathrm{e}-09)$ |
| Size dummy | $2.83 \mathrm{e}-07^{* * *}$ | $1.75 \mathrm{e}-07^{* * *}$ | $2.97 \mathrm{e}-07^{* * *}$ | $2.11 \mathrm{e}-07^{* * *}$ | $3.14 \mathrm{e}-07^{* * *}$ |
|  | $(3.39 \mathrm{e}-09)$ | $(5.68 \mathrm{e}-09)$ | $(3.63 \mathrm{e}-09)$ | $(4.90 \mathrm{e}-09)$ | $(4.03 \mathrm{e}-09)$ |
| Time outstanding | $6.77 \mathrm{e}-08^{* * *}$ | $1.25 \mathrm{e}-07^{* * *}$ | $6.50 \mathrm{e}-08^{* * *}$ | $8.64 \mathrm{e}-08^{* * *}$ | $6.01 \mathrm{e}-08^{* * *}$ |
|  | $(4.46 \mathrm{e}-09)$ | $(3.07 \mathrm{e}-08)$ | $(4.76 \mathrm{e}-09)$ | $(1.02 \mathrm{e}-08)$ | $(5.37 \mathrm{e}-09)$ |
| Log(issue size) | $-2.80 \mathrm{e}-08^{* * *}$ | $-3.07 \mathrm{e}-08$ | $-2.67 \mathrm{e}-08^{* * *}$ | $-1.58 \mathrm{e}-08$ | $-2.66 \mathrm{e}-08^{* * *}$ |
|  | $(8.56 \mathrm{e}-09)$ | $(2.33 \mathrm{e}-08)$ | $(8.28 \mathrm{e}-09)$ | $(1.83 \mathrm{e}-08)$ | $(7.68 \mathrm{e}-09)$ |
| Log(bond size) | $4.24 \mathrm{e}-08^{* * *}$ | $1.78 \mathrm{e}-08^{* * *}$ | $4.48 \mathrm{e}-08^{* * *}$ | $8.81 \mathrm{e}-09$ | $5.62 \mathrm{e}-08^{* * *}$ |
|  | $(4.22 \mathrm{e}-09)$ | $(5.76 \mathrm{e}-09)$ | $(4.68 \mathrm{e}-09)$ | $(1.13 \mathrm{e}-08)$ | $(4.28 \mathrm{e}-09)$ |
| Offering dummy | $2.39 \mathrm{e}-08^{* *}$ | $4.98 \mathrm{e}-08^{*}$ | $2.57 \mathrm{e}-08^{* *}$ | $7.90 \mathrm{e}-09$ | $2.66 \mathrm{e}-08^{* *}$ |
|  | $(1.04 \mathrm{e}-08)$ | $(2.92 \mathrm{e}-08)$ | $(1.13 \mathrm{e}-08)$ | $(1.45 \mathrm{e}-08)$ | $1.48 \mathrm{e}-08$ |
| Constant | $-3.53 \mathrm{e}-07^{* *}$ | $1.73 \mathrm{e}-07$ | $-4.32 \mathrm{e}-07^{* * *}$ | $(2.30 \mathrm{e}-07)$ | $-6.68 \mathrm{e}-07^{* * * *}$ |
|  | $(1.37 \mathrm{e}-07)$ | $(3.69 \mathrm{e}-07)$ | $(1.32 \mathrm{e}-07)$ | $(1.37 \mathrm{e}-07)$ |  |
| Observations |  |  |  | 168,937 | 54,428 |
| R-squared | 190,697 | 0.760 | 0.139 | 0.097 | 136,269 |

Table 4.34: Average difference in Amihud measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bonds with an A pure rating
This table shows results from the ordinary least squares regression of the Amihud measure on an insured dummy
where Amihud $_{i}$ represents the Amihud measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |
| Insurance effect | $1.01 \mathrm{e}-07^{* * *}$ | $4.35 \mathrm{e}-08^{* *}$ | $1.06 \mathrm{e}-07^{* * *}$ | $7.97 \mathrm{e}-08^{* * *}$ | $1.17 \mathrm{e}-07^{* * *}$ |
|  | $(2.15 \mathrm{e}-08)$ | $(2.15 \mathrm{e}-08)$ | $(2.35 \mathrm{e}-08)$ | $(2.06 \mathrm{e}-08)$ | $(2.92 \mathrm{e}-08)$ |
| Log(maturity) | $9.53 \mathrm{e}-08^{* * *}$ | $4.27 \mathrm{e}-08^{* * *}$ | $1.00 \mathrm{e}-07^{* * *}$ | $4.83 \mathrm{e}-08^{* * *}$ | $1.05 \mathrm{e}-07^{* * *}$ |
|  | $(5.72 \mathrm{e}-09)$ | $(7.62 \mathrm{e}-09)$ | $(6.28 \mathrm{e}-09)$ | $(5.50 \mathrm{e}-09)$ | $(7.50 \mathrm{e}-09)$ |
| Size dummy | $2.90 \mathrm{e}-07^{* * *}$ | $1.70 \mathrm{e}-07^{* * *}$ | $3.09 \mathrm{e}-07^{* * *}$ | $2.10 \mathrm{e}-07^{* * *}$ | $3.40 \mathrm{e}-07^{* * *}$ |
|  | $(5.08 \mathrm{e}-09)$ | $(6.70 \mathrm{e}-09)$ | $(5.54 \mathrm{e}-09)$ | $(5.12 \mathrm{e}-09)$ | $(7.12 \mathrm{e}-09)$ |
| Time outstanding | $3.92 \mathrm{e}-08^{* * *}$ | $5.91 \mathrm{e}-08^{* *}$ | $3.46 \mathrm{e}-08^{* * *}$ | $6.51 \mathrm{e}-08^{* * *}$ | $2.91 \mathrm{e}-08^{* * *}$ |
|  | $(7.14 \mathrm{e}-09)$ | $(2.65 \mathrm{e}-08)$ | $(8.00 \mathrm{e}-09)$ | $(1.02 \mathrm{e}-08)$ | $(9.88 \mathrm{e}-09)$ |
| Log(issue size) | $-1.77 \mathrm{e}-08^{* *}$ | $6.62 \mathrm{e}-09$ | $-2.17 \mathrm{e}-08^{* *}$ | $3.03 \mathrm{e}-09$ | $-3.02 \mathrm{e}-08^{* * *}$ |
|  | $(8.56 \mathrm{e}-09)$ | $(1.25 \mathrm{e}-08)$ | $(9.50 \mathrm{e}-09)$ | $(8.06 \mathrm{e}-09)$ | $(1.14 \mathrm{e}-08)$ |
| Log(bond size) | $3.44 \mathrm{e}-08^{* * *}$ | $6.82 \mathrm{e}-09$ | $3.75 \mathrm{e}-08^{* * *}$ | $1.03 \mathrm{e}-08^{* * *}$ | $4.78 \mathrm{e}-08^{* * *}$ |
|  | $(4.41 \mathrm{e}-09)$ | $(4.54 \mathrm{e}-09)$ | $(4.90 \mathrm{e}-09)$ | $(3.91 \mathrm{e}-09)$ | $(5.91 \mathrm{e}-09)$ |
| Offering dummy | $-3.90 \mathrm{e}-09$ | $-8.06 \mathrm{e}-09$ | $-1.76 \mathrm{e}-08$ | $3.27 \mathrm{e}-10$ |  |
|  | $(2.27 \mathrm{e}-08)$ | $(2.85 \mathrm{e}-08$ | $(2.55 \mathrm{e}-08)$ | $-08)$ | $(3.04 \mathrm{e}-08)$ |
| Constant | $-5.00 \mathrm{e}-07^{* * *}$ | $-4.30 \mathrm{e}-07^{*}$ | $-4.99 \mathrm{e}-07^{* * *}$ | $-3.75 \mathrm{e}-087^{* *}$ | $-2.99 \mathrm{e}-07$ |
|  | $(1.50 \mathrm{e}-07)$ | $(2.49 \mathrm{e}-07)$ | $(1.59 \mathrm{e}-07)$ | $(1.60 \mathrm{e}-07)$ | $(1.97 \mathrm{e}-07)$ |
| Observations |  |  |  | 85,239 | 33,725 |
| R-squared | 98,372 | 13,133 | 0.117 | 0.142 | 64,647 |

Table 4.35: Average difference in Amihud measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bonds with a AAA actual rating
This table shows results from the ordinary least squares regression of the Amihud measure on an insured dummy
where Amihud $_{i}$ represents the Amihud measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |
| Insurance effect | $7.98 \mathrm{e}-08^{* * *}$ | $6.18 \mathrm{e}-09$ | $8.98 \mathrm{e}-08^{* * *}$ | $2.18 \mathrm{e}-08$ | $\left(4.01 \mathrm{e}-07^{* *}\right.$ |
|  | $(2.43 \mathrm{e}-08)$ | $(2.69 \mathrm{e}-08)$ | $(2.72 \mathrm{e}-08)$ | $(1.88 \mathrm{e}-08)$ | $(4.11 \mathrm{e}-08)$ |
| Log(maturity) | $8.89 \mathrm{e}-08^{* * *}$ | $4.36 \mathrm{e}-08^{* * *}$ | $9.26 \mathrm{e}-08^{* * *}$ | $6.09 \mathrm{e}-08^{* * *}$ | $9.30 \mathrm{e}-08^{* * *}$ |
|  | $(4.17 \mathrm{e}-09)$ | $(5.74 \mathrm{e}-09)$ | $(4.54 \mathrm{e}-09)$ | $(6.82 \mathrm{e}-09)$ | $(4.99 \mathrm{e}-09)$ |
| Size dummy | $3.02 \mathrm{e}-07^{* * *}$ | $2.01 \mathrm{e}-07^{* * *}$ | $3.18 \mathrm{e}-07^{* * *}$ | $2.41 \mathrm{e}-07^{* * *}$ | $3.39 \mathrm{e}-07^{* * *}$ |
|  | $(3.31 \mathrm{e}-09)$ | $(5.57 \mathrm{e}-09)$ | $(3.67 \mathrm{e}-09)$ | $(4.56 \mathrm{e}-09)$ | $(4.41 \mathrm{e}-09)$ |
| Time outstanding | $5.60 \mathrm{e}-08^{* * *}$ | $6.77 \mathrm{e}-08^{* * *}$ | $5.31 \mathrm{e}-08^{* * *}$ | $5.54 \mathrm{e}-08^{* * *}$ | $4.68 \mathrm{e}-08^{* * *}$ |
|  | $(4.39 \mathrm{e}-09)$ | $(2.13 \mathrm{e}-08)$ | $(4.64 \mathrm{e}-09)$ | $(7.51 \mathrm{e}-09)$ | $(5.57 \mathrm{e}-09)$ |
| Log(issue size) | $-1.25 \mathrm{e}-08$ | $8.19 \mathrm{e}-10$ | $-1.54 \mathrm{e}-08^{*}$ | $1.27 \mathrm{e}-08$ | $-2.55 \mathrm{e}-08^{* * *}$ |
|  | $(7.82 \mathrm{e}-09)$ | $(7.60 \mathrm{e}-09)$ | $(9.17 \mathrm{e}-09)$ | $(1.56 \mathrm{e}-08)$ | $(9.38 \mathrm{e}-09)$ |
| Log(bond size) | $3.45 \mathrm{e}-08^{* * *}$ | $3.77 \mathrm{e}-09$ | $3.72 \mathrm{e}-08^{* * *}$ | $-3.69 \mathrm{e}-09$ | $5.43 \mathrm{e}-08^{* * *}$ |
|  | $(5.62 \mathrm{e}-09)$ | $(4.48 \mathrm{e}-09)$ | $(6.23 \mathrm{e}-09)$ | $(1.12 \mathrm{e}-08)$ | $(6.23 \mathrm{e}-09)$ |
| Offering dummy | $3.08 \mathrm{e}-08^{* * *}$ | $5.76 \mathrm{e}-08^{* *}$ | $3.30 \mathrm{e}-08^{* * *}$ | $2.84 \mathrm{e}-08^{* *}$ | $4.09 \mathrm{e}-08^{* * *}$ |
| Constant | $(1.10 \mathrm{e}-08)$ | $(2.35 \mathrm{e}-08)$ | $(1.23 \mathrm{e}-08)$ | $(1.45 \mathrm{e}-08)$ | $(1.53 \mathrm{e}-08)$ |
|  | $-6.37 \mathrm{e}-07^{* * *}$ | $-2.19 \mathrm{e}-07^{*}$ | $-5.91 \mathrm{e}-07^{* * *}$ | $-3.68 \mathrm{e}-07^{* *}$ | $-6.89 \mathrm{e}-07^{* * *}$ |
| Observations | $(1.25 \mathrm{e}-07)$ | $(1.31 \mathrm{e}-07)$ | $(1.36 \mathrm{e}-07)$ | $(1.63 \mathrm{e}-07)$ | $(1.69 \mathrm{e}-07)$ |
| R-squared |  |  |  | 146,197 | 64,780 |

Table 4.36: Average difference in Amihud measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bonds with a AA actual rating
This table shows results from the ordinary least squares regression of the Amihud measure on an insured dummy
where Amihud $_{i}$ represents the Amihud measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |
| Insurance effect | $3.45 \mathrm{e}-08^{* * *}$ | $-3.74 \mathrm{e}-08^{* * *}$ | $4.00 \mathrm{e}-08^{* * *}$ | $-5.83 \mathrm{e}-09$ | $3.62 \mathrm{e}-08^{*}$ |
|  | $(1.34 \mathrm{e}-08)$ | $(1.37 \mathrm{e}-08)$ | $(1.55 \mathrm{e}-08)$ | $(1.13 \mathrm{e}-08)$ | $(1.89 \mathrm{e}-08)$ |
| Log(maturity) | $7.36 \mathrm{e}-08^{* * *}$ | $4.29 \mathrm{e}-08^{* * *}$ | $7.45 \mathrm{e}-08^{* * *}$ | $4.66 \mathrm{e}-08^{* * *}$ | $7.60 \mathrm{e}-08^{* * *}$ |
|  | $(3.20 \mathrm{e}-09)$ | $(6.14 \mathrm{e}-09)$ | $(3.41 \mathrm{e}-09)$ | $(4.04 \mathrm{e}-09)$ | $(3.77 \mathrm{e}-09)$ |
| Size dummy | $2.70 \mathrm{e}-07^{* * *}$ | $1.33 \mathrm{e}-07^{* * *}$ | $2.84 \mathrm{e}-07^{* * *}$ | $1.67 \mathrm{e}-07^{* * *}$ | $3.03 \mathrm{e}-07^{* * *}$ |
|  | $(3.78 \mathrm{e}-09)$ | $(6.71 \mathrm{e}-09)$ | $(4.01 \mathrm{e}-09)$ | $(4.78 \mathrm{e}-09)$ | $(4.52 \mathrm{e}-09)$ |
| Time outstanding | $7.10 \mathrm{e}-08^{* * *}$ | $1.50 \mathrm{e}-07^{* * *}$ | $6.70 \mathrm{e}-08^{* * *}$ | $9.03 \mathrm{e}-08^{* * *}$ | $6.39 \mathrm{e}-08^{* * *}$ |
|  | $(4.85 \mathrm{e}-09)$ | $(2.99 \mathrm{e}-08)$ | $(5.08 \mathrm{e}-09)$ | $(9.95 \mathrm{e}-09)$ | $(5.68 \mathrm{e}-09)$ |
| Log(issue size) | $-3.06 \mathrm{e}-08^{* * *}$ | $-3.06 \mathrm{e}-08$ | $-2.75 \mathrm{e}-08^{* * *}$ | $-2.14 \mathrm{e}-08^{*}$ | $-2.51 \mathrm{e}-08^{* * *}$ |
|  | $(7.81 \mathrm{e}-09)$ | $(2.20 \mathrm{e}-08)$ | $(7.51 \mathrm{e}-09)$ | $(1.22 \mathrm{e}-08)$ | $(7.79 \mathrm{e}-09)$ |
| Log(bond size) | $4.74 \mathrm{e}-08^{* * *}$ | $1.87 \mathrm{e}-08^{* * *}$ | $4.92 \mathrm{e}-08^{* * *}$ | $1.93 \mathrm{e}-08^{* * *}$ | $5.52 \mathrm{e}-08^{* * *}$ |
|  | $(3.52 \mathrm{e}-09)$ | $(6.98 \mathrm{e}-09)$ | $(3.74 \mathrm{e}-09)$ | $(4.46 \mathrm{e}-09)$ | $(4.14 \mathrm{e}-09)$ |
| Offering dummy | $1.71 \mathrm{e}-08$ | $4.81 \mathrm{e}-08$ | $1.90 \mathrm{e}-08$ | $-9.11 \mathrm{e}-10$ | $1.91 \mathrm{e}-08$ |
|  | $(1.12 \mathrm{e}-08)$ | $(3.40 \mathrm{e}-08)$ | $(1.23 \mathrm{e}-08)$ | $(1.63 \mathrm{e}-08)$ | $-3.90 \mathrm{e}-08$ |
| Constant | $-3.75 \mathrm{e}-07^{* * *}$ | $1.47 \mathrm{e}-07$ | $-1.38 \mathrm{e}-07^{* * *}$ | $(1.81 \mathrm{e}-07)$ | $-7.23 \mathrm{e}-07^{* * * *}$ |
|  | $(1.36 \mathrm{e}-07)$ | $(3.22 \mathrm{e}-07)$ | $(1.36 \mathrm{e}-07)$ | $(1.44 \mathrm{e}-07)$ |  |
| Observations |  |  |  | 135,045 | 33,688 |
| R-squared | 149,346 | $0.14,301$ | 0.158 | 0.151 | 115,658 |

Table 4.37: Average difference in Amihud measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bonds with a $A$ actual rating
This table shows results from the ordinary least squares regression of the Amihud measure on an insured dummy
where Amihud $_{i}$ represents the Amihud measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |
| Insurance effect | $9.23 \mathrm{e}-08^{* * *}$ | $-8.95 \mathrm{e}-09$ | $9.70 \mathrm{e}-08^{* * *}$ | $-2.53 \mathrm{e}-10$ | $1.15 \mathrm{e}-07^{* * *}$ |
|  | $(2.68 \mathrm{e}-08)$ | $(1.76 \mathrm{e}-08)$ | $(2.90 \mathrm{e}-08)$ | $(1.31 \mathrm{e}-08)$ | $(3.44 \mathrm{e}-08)$ |
| Log(maturity) | $8.96 \mathrm{e}-08^{* * *}$ | $3.25 \mathrm{e}-08^{* * *}$ | $9.53 \mathrm{e}-08^{* * *}$ | $3.56 \mathrm{e}-08^{* * *}$ | $1.03 \mathrm{e}-07^{* * *}$ |
|  | $(6.57 \mathrm{e}-09)$ | $(8.79 \mathrm{e}-09)$ | $(7.10 \mathrm{e}-09)$ | $(5.54 \mathrm{e}-09)$ | $(8.27 \mathrm{e}-09)$ |
| Size dummy | $2.67 \mathrm{e}-07^{* * *}$ | $1.13 \mathrm{e}-07^{* * *}$ | $2.87 \mathrm{e}-07^{* * *}$ | $1.49 \mathrm{e}-07^{* * *}$ | $3.21 \mathrm{e}-07^{* * *}$ |
|  | $(6.54 \mathrm{e}-09)$ | $(8.35 \mathrm{e}-09)$ | $(7.05 \mathrm{e}-09)$ | $(6.18 \mathrm{e}-09)$ | $(8.52 \mathrm{e}-09)$ |
| Time outstanding | $5.00 \mathrm{e}-08^{* * *}$ | $1.37 \mathrm{e}-07^{* *}$ | $4.65 \mathrm{e}-08^{* * *}$ | $7.17 \mathrm{e}-08^{* * *}$ | $4.19 \mathrm{e}-08^{* * *}$ |
|  | $(9.14 \mathrm{e}-09)$ | $(5.93 \mathrm{e}-08)$ | $(1.00 \mathrm{e}-08)$ | $(1.56 \mathrm{e}-08)$ | $(1.16 \mathrm{e}-08)$ |
| Log(issue size) | $-9.52 \mathrm{e}-09$ | $-2.30 \mathrm{e}-10$ | $-8.96 \mathrm{e}-09$ | $-3.64 \mathrm{e}-09$ | $-1.04 \mathrm{e}-08$ |
|  | $(9.51 \mathrm{e}-09)$ | $(1.44 \mathrm{e}-08)$ | $(1.04 \mathrm{e}-08)$ | $(8.67 \mathrm{e}-09)$ | $(1.21 \mathrm{e}-08)$ |
| Log(bond size) | $3.58 \mathrm{e}-08^{* * *}$ | $5.84 \mathrm{e}-09$ | $3.74 \mathrm{e}-08^{* * *}$ | $1.10 \mathrm{e}-08^{* * *}$ | $4.31 \mathrm{e}-08^{* * *}$ |
|  | $(5.06 \mathrm{e}-09)$ | $(4.70 \mathrm{e}-09)$ | $(5.59 \mathrm{e}-09)$ | $(3.85 \mathrm{e}-09)$ | $(6.58 \mathrm{e}-09)$ |
| Offering dummy | $-1.38 \mathrm{e}-10$ | $-1.45 \mathrm{e}-08$ | $7.45 \mathrm{e}-10$ | $-5.85 \mathrm{e}-08^{* *}$ | $2.58 \mathrm{e}-08$ |
|  | $(2.85 \mathrm{e}-08)$ | $(4.32 \mathrm{e}-08)$ | $(3.16 \mathrm{e}-08)$ | $(2.62 \mathrm{e}-08)$ | $-1.30 \mathrm{e}-07$ |
| Constant | $-6.10 \mathrm{e}-07^{* * *}$ | $-1.03 \mathrm{e}-07$ | $-6.67 \mathrm{e}-07^{* * *}$ | $(1.83 \mathrm{e}-07)$ | $-7.71 \mathrm{e}-07^{* * *}$ |
|  | $(1.67 \mathrm{e}-07)$ | $(3.14 \mathrm{e}-07)$ | $(1.75 \mathrm{e}-07)$ | $(2.04 \mathrm{e}-07)$ |  |
| Observations |  |  |  |  |  |
| R-squared | 61,046 | 7,705 | 53,341 | 0.132 | 43,764 |

Table 4.38: Effect of change in insurance status on the Amihud measure with time controls
This table shows results from the difference in difference regression below:

$$
\begin{aligned}
\text { Amihud }_{i, j} & =\beta_{1} * \text { Insured }+\beta_{2} * \text { PreEvent } * \text { Insured }+\beta_{3} * \text { PreEvent }+\underline{\beta} * X_{i, j} \\
& +\beta * X_{i, j} * \text { PreEvent }+\beta_{s} * \gamma_{s} * \text { PreEvent }+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i, j}
\end{aligned}
$$

where Amihud $_{i, j}$ represents the Amihud measure for municipal bond i, issued by issuer j. PreEvent is 1 if date of measure is before the give event, and $X_{i, j}$ is a vector of k standard controls, Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, and $\epsilon_{i}$ is an error term. Each specification, is a different event. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is run using the stock price drop of the insurers as the event. Specification 2 is run using the downgrade of the insurers as the event.

|  | Stock Drop | Ratings Downgrade |
| :--- | :---: | :---: |
| insuredpartial | $-3.93 \mathrm{e}-09$ | $1.06 \mathrm{e}-09$ |
|  | $(8.39 \mathrm{e}-09)$ | $(9.00 \mathrm{e}-09)$ |
| predowngrade |  | $-6.37 \mathrm{e}-10$ |
|  |  | $(1.54 \mathrm{e}-08)$ |
| Insurance effect | $1.90 \mathrm{e}-08^{* *}$ | $1.83 \mathrm{e}-08^{* *}$ |
|  | $(7.48 \mathrm{e}-09)$ | $(8.88 \mathrm{e}-09)$ |
| Log(maturity) | $1.06 \mathrm{e}-07^{* * *}$ | $1.02 \mathrm{e}-07^{* * *}$ |
|  | $(3.12 \mathrm{e}-09)$ | $(2.89 \mathrm{e}-09)$ |
| Size dummy | $3.25 \mathrm{e}-07^{* * *}$ | $3.08 \mathrm{e}-07^{* * *}$ |
|  | $(3.04 \mathrm{e}-09)$ | $(2.83 \mathrm{e}-09)$ |
| Time outstanding | $7.41 \mathrm{e}-08^{* * *}$ | $7.64 \mathrm{e}-08^{* * *}$ |
|  | $(3.12 \mathrm{e}-09)$ | $(3.27 \mathrm{e}-09)$ |
| Log(issue size) | $-2.66 \mathrm{e}-08^{* * *}$ | $-2.37 \mathrm{e}-08^{* * *}$ |
|  | $(3.40 \mathrm{e}-09)$ | $(3.24 \mathrm{e}-09)$ |
| Log(bond size) | $4.46 \mathrm{e}-08^{* * *}$ | $4.19 \mathrm{e}-08^{* * *}$ |
|  | $(3.58 \mathrm{e}-09)$ | $(3.35 \mathrm{e}-09)$ |
| Offering dummy | $-1.02 \mathrm{e}-08^{* *}$ | $-1.27 \mathrm{e}-08^{* *}$ |
|  | $(5.17 \mathrm{e}-09)$ | $(5.14 \mathrm{e}-09)$ |
| Constant | $-3.41 \mathrm{e}-07^{* * *}$ | $-4.85 \mathrm{e}-07^{* * *}$ |
|  | $(4.14 \mathrm{e}-08)$ | $(3.98 \mathrm{e}-08)$ |
| Observations |  |  |
| R-squared | 389,486 | 389,486 |

Table 4.39: Effect of change in insurance status on the Amihud measure with time controls, issuer controls, underlying rating dummies and controls
This table shows results from the difference in difference regression below:

$$
\begin{aligned}
\text { Amihud }_{i, j} & =\beta_{1} * \text { Insured }+\beta_{2} * \text { PreEvent } * \text { Insured }+\beta_{3} * \text { PreEvent }+\underline{\beta} * X_{i, j} \\
& +\beta * X_{i, j} * \text { PreEvent }+\beta_{s} * \gamma_{s} * \text { PreEvent }+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i, j}
\end{aligned}
$$

where Amihud $_{i, j}$ represents the Amihud measure for municipal bond i, issued by issuer j. PreEvent is 1 if date of measure is before the give event, and $X_{i, j}$ is a vector of k standard controls, Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, and $\epsilon_{i}$ is an error term. Each specification, is a different event. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is run using the stock price drop of the insurers as the event. Specification 2 is run using the downgrade of the insurers as the event.

|  | Stock Drop | Ratings Downgrade |
| :--- | :---: | :---: |
|  |  |  |
| insuredpartial | $1.11 \mathrm{e}-08$ | $1.89 \mathrm{e}-08^{* *}$ |
|  | $(1.10 \mathrm{e}-08)$ | $(9.52 \mathrm{e}-09)$ |
| Insurance effect | $6.13 \mathrm{e}-08^{* * *}$ | $5.71 \mathrm{e}-08^{* * *}$ |
|  | $(8.71 \mathrm{e}-09)$ | $(9.83 \mathrm{e}-09)$ |
| Log(maturity) | $8.77 \mathrm{e}-08^{* * *}$ | $9.58 \mathrm{e}-08^{* * *}$ |
|  | $(2.60 \mathrm{e}-09)$ | $(2.92 \mathrm{e}-09)$ |
| Size dummy | $3.05 \mathrm{e}-07^{* * *}$ | $3.32 \mathrm{e}-07^{* * *}$ |
|  | $(2.56 \mathrm{e}-09)$ | $(3.05 \mathrm{e}-09)$ |
| Time outstanding | $6.09 \mathrm{e}-08^{* * *}$ | $5.71 \mathrm{e}-08^{* * *}$ |
|  | $(3.02 \mathrm{e}-09)$ | $(3.28 \mathrm{e}-09)$ |
| Log(issue size) | $-2.15 \mathrm{e}-08^{* * *}$ | $-3.01 \mathrm{e}-08^{* * *}$ |
|  | $(5.21 \mathrm{e}-09)$ | $(5.13 \mathrm{e}-09)$ |
| Log(bond size) | $4.30 \mathrm{e}-08^{* * *}$ | $5.25 \mathrm{e}-08^{* * *}$ |
|  | $(3.07 \mathrm{e}-09)$ | $(3.25 \mathrm{e}-09)$ |
| Offering dummy | $2.17 \mathrm{e}-08^{* *}$ | $2.03 \mathrm{e}-08^{* *}$ |
| Constant | $(8.53 \mathrm{e}-09)$ | $(8.57 \mathrm{e}-09)$ |
|  | $-5.36 \mathrm{e}-07^{* * *}$ | $-4.86 \mathrm{e}-07^{* * *}$ |
| Observations | $(1.03 \mathrm{e}-07)$ | $(9.76 \mathrm{e}-08)$ |
| R-squared |  |  |

Table 4.40: Average difference in Amihud measure between AAA-rated and non AAA-rated municipal bonds with issuer fixed effects, time fixed effects and controls
This table shows results from the ordinary least squares regression of the Amihud measure on a AAA dummy

## Amihud $_{i}=\beta_{1} * A A A+\underline{\beta} * X_{i, k}+\beta_{\text {Issuer }} * \gamma_{\text {Issuer }}+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i}$

where Amihud $_{i}$ represents the Amihud measure for municipal bond i, AAA is one if bond i has an actual rating of AAA and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.
Pre Stock Drop
$\begin{array}{cc}341,261 & 119,339 \\ 0.136 & 0.115\end{array}$
Full Sample
Pre Downgrade Post Downgrade

270,147
0.148

$$
5.95 \mathrm{e}-08^{* * *}
$$

$5.95 \mathrm{e}-08$
$(5.42 \mathrm{e}-09)$
$5.16 \mathrm{e}-08^{* * *}$
(3.74e-09) $2.06 \mathrm{e}-07^{* * *}$ $(2.94 \mathrm{e}-09)$
$7.14 \mathrm{e}-08^{* * *}$ $(5.90 \mathrm{e}-09)$
$-3.84 \mathrm{e}-09$ $-3.84 \mathrm{e}-09$
$(9.01 \mathrm{e}-09)$ $7.00 \mathrm{e}-09$
$(5.48 \mathrm{e}-09)$ -1.57e-09 (9.94e-09) $\begin{array}{ll}\text { E } \\ 0 & 0 \\ 0 & 1 \\ N & 0 \\ i & =\end{array}$
Post Stock Drop
 $0.231-0.136$
$6.10 \mathrm{e}-08^{* * *}$ (6.01e-09) $\stackrel{(3.70 \mathrm{e}-09)}{ }$ $1.68 \mathrm{e}-07^{* * *}$ (3.97e-09) (1.64e-08) -1.28e-08 (1.18e-08
$1.05 \mathrm{e}-08^{* * *}$ (3.49e-09) $3.71 \mathrm{e}-08^{* *}$
$(1.60 \mathrm{e}-08)$ $-5.61 \mathrm{e}-08$ 48,225
0.231

$$
3.42 \mathrm{e}-08^{* * *}
$$ $\stackrel{(2.42 \mathrm{e}-09)}{ }$ $2.86 \mathrm{e}-07^{* * *}$

$(2.39 \mathrm{e}-09)$ $6.97 \mathrm{e}-08^{* * *}$
$(2.82 \mathrm{e}-09)$ $-1.67 \mathrm{e}-08^{* * *}$ $(5.17 \mathrm{e}-09)$
$3.98 \mathrm{e}-08^{* * *}$ (2.85e-09) 1.91e-08**
 389,486
0.135

[^5]$\log$ (maturity)
Size dummy
Time outstanding
$\log ($ issue size $)$
$\log$ (bond size)
Offering dummy
Constant

| Observations |
| :--- |
| R-squared |

$$
\begin{aligned}
& 3.42 \mathrm{e}-08 \\
& (5.87 \mathrm{e}-09)
\end{aligned}
$$

Table 4.41: Average difference in Bid-Ask measure between insured and uninsured municipal bonds with controls and time fixed effects
This table shows results from the ordinary least squares regression of the bid-ask measure on an insured dummy, controls and time fixed effects
where $B i d A s k_{i}$ represents the bid-ask liquidity measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. *, **, and *** denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |
| Insurance effect | $0.00157^{* * *}$ | $0.00160^{* * *}$ | $0.00159^{* * *}$ | $0.00163^{* * *}$ | $0.00146^{* * *}$ |
|  | $(0.000222)$ | $(0.000254)$ | $(0.000245)$ | $(0.000244)$ | $(0.000311)$ |
| Log(maturity) | $0.00278^{* * *}$ | $0.00178^{* * *}$ | $0.00294^{* * *}$ | $0.00265^{* * *}$ | $0.00297^{* * *}$ |
|  | $\left(9.17 \mathrm{e}^{*}-05\right)$ | $(0.000169)$ | $(9.98 \mathrm{e}-05)$ | $(0.000117)$ | $(0.000116)$ |
| Size dummy | $0.00182^{* * *}$ | $0.00252^{* * *}$ | $0.00162^{* * *}$ | $0.00198^{* * *}$ | $0.00167^{* * *}$ |
|  | $(8.91 \mathrm{e}-05)$ | $(0.000165)$ | $(9.89 \mathrm{e}-05)$ | $(0.000115)$ | $(0.000119)$ |
| Time outstanding | $0.00122^{* * *}$ | $0.00170^{* * *}$ | $0.00114^{* * *}$ | $0.00157^{* * *}$ | $0.00107^{* * *}$ |
| Log(issue size) | $(9.09 \mathrm{e}-05)$ | $(0.000544)$ | $(8.92 \mathrm{e}-05)$ | $(0.000150)$ | $(9.42 \mathrm{e}-05)$ |
|  | $0.000174^{* * *}$ | $0.000278^{* *}$ | $0.000168^{* *}$ | $0.000432^{* * *}$ | $6.32 \mathrm{e}-05$ |
| Log(bond size) | $(6.68 \mathrm{e}-05)$ | $(0.000116)$ | $(7.34 \mathrm{e}-05)$ | $(8.08 \mathrm{e}-05)$ | $(8.57 \mathrm{e}-05)$ |
|  | $0.00179^{* * *}$ | $0.000936^{* * *}$ | $0.00188^{* * *}$ | $0.000872^{* * *}$ | $0.00215^{* * *}$ |
| Offering dummy | $(9.05 \mathrm{e}-05)$ | $(0.000137)$ | $(9.60 \mathrm{e}-05)$ | $(0.000108)$ | $(0.000108)$ |
|  | $0.00128^{* * *}$ | $0.00273^{* * *}$ | $0.00109^{* * *}$ | $0.00146^{* * *}$ | $0.00110^{* * *}$ |
| Constant | $(0.000128)$ | $(0.000291)$ | $(0.000142)$ | $(0.000180)$ | $(0.000176)$ |
|  | $-0.0375^{* * *}$ | $-0.0232^{* * *}$ | $-0.0376^{* * *}$ | $-0.0276^{* * *}$ | $-0.0406^{* * *}$ |
| Observations | $(0.00152)$ | $(0.00226)$ | $(0.00159)$ | $(0.00193)$ | $(0.00188)$ |
| R-squared |  |  |  |  |  |

Table 4.42: Average difference in Bid-Ask measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls
This table shows results from the ordinary least squares regression of the Bid-Ask measure on an insured dummy
where $B_{i d A s k}^{i}$ represents the bid-ask measure for municipal bond i , Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insurance effect | $0.00164^{* * *}$ $(0.000281)$ | $0.00246^{* * *}$ <br> (0.000693) | $0.00156^{* * *}$ $(0.000316)$ | $0.00206^{* * *}$ <br> (0.000463) | $0.00153^{* * *}$ |
| Log(maturity) | $\begin{gathered} 0.00293^{* * *} \\ (9.47 \mathrm{e}-05) \end{gathered}$ | $\begin{gathered} 0.00139^{* * *} \\ (0.000201) \end{gathered}$ | $\begin{gathered} 0.00309^{* * *} \\ (0.000104) \end{gathered}$ | $\begin{gathered} 0.00265^{* * *} \\ (0.000130) \end{gathered}$ | $\begin{gathered} 0.00310^{* * *} \\ (0.000135) \end{gathered}$ |
| Size dummy | $\begin{gathered} 0.00160^{* * *} \\ (9.38 \mathrm{e}-05) \end{gathered}$ | $\begin{gathered} 0.00191^{* * *} \\ (0.000193) \end{gathered}$ | $\begin{aligned} & 0.00138^{* * *} \\ & (0.000104) \end{aligned}$ | $\begin{gathered} 0.00166^{* * *} \\ (0.000126) \end{gathered}$ | $\begin{gathered} 0.00136^{* * *} \\ (0.000126) \end{gathered}$ |
| Time outstanding | $\begin{gathered} 0.00142^{* * *} \\ (0.000116) \end{gathered}$ | $\begin{gathered} 0.000436 \\ (0.000621) \end{gathered}$ | $\begin{gathered} 0.00137^{* * *} \\ (0.000127) \end{gathered}$ | $\begin{gathered} 0.00151^{* * *} \\ (0.000198) \end{gathered}$ | $\begin{gathered} 0.00128^{* * *} \\ (0.000150) \end{gathered}$ |
| Log(issue size) | $\begin{gathered} 0.000161 \\ (0.000125) \end{gathered}$ | $\begin{gathered} -0.000107 \\ (0.000304) \end{gathered}$ | $\begin{gathered} 0.000215 \\ (0.000140) \end{gathered}$ | $\begin{gathered} 6.38 \mathrm{e}-05 \\ (0.000181) \end{gathered}$ | $\begin{gathered} 0.000135 \\ (0.000177) \end{gathered}$ |
| Log(bond size) | $\begin{gathered} 0.00140^{* * *} \\ (7.85 \mathrm{e}-05) \end{gathered}$ | $\begin{gathered} 0.000491^{* * *} \\ (0.000133) \end{gathered}$ | $\begin{gathered} 0.00149^{* * *} \\ (8.46 \mathrm{e}-05) \end{gathered}$ | $\begin{gathered} 0.000580^{* * *} \\ (9.52 \mathrm{e}-05) \end{gathered}$ | $\begin{gathered} 0.00166^{* * *} \\ (0.000106) \end{gathered}$ |
| Offering dummy | $\begin{gathered} 0.00110^{* * *} \\ (0.000322) \end{gathered}$ | $\begin{gathered} 0.00251^{* * *} \\ (0.000785) \end{gathered}$ | $\begin{gathered} 0.000855^{* *} \\ (0.000368) \end{gathered}$ | $\begin{aligned} & 0.000955^{*} \\ & (0.000497) \end{aligned}$ | $\begin{aligned} & 0.000750^{*} \\ & (0.000428) \end{aligned}$ |
| Constant | $\begin{gathered} -0.0297^{* * *} \\ (0.00227) \end{gathered}$ | $\begin{aligned} & -0.0102^{*} \\ & (0.00549) \end{aligned}$ | $\begin{gathered} -0.0310^{* * *} \\ (0.00253) \end{gathered}$ | $\begin{gathered} -0.0149^{* * *} \\ (0.00314) \end{gathered}$ | $\begin{gathered} -0.0301^{* * *} \\ (0.00327) \end{gathered}$ |
| Observations | 71,277 | 8,885 | 62,392 | 24,321 | 46,956 |
| R-squared | 0.271 | 0.343 | 0.260 | 0.322 | 0.269 |

Table 4.43: Average difference in Bid-Ask measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects, underlying rating dummies and controls
This table shows results from the ordinary least squares regression of the Bid-Ask measure on an insured dummy
Bidask $_{i}=\beta_{1} *$ Insured $+\beta_{2} * A A_{i}+\beta_{3} * A_{i}+\beta_{4} * B B B+{ }_{i}+\underline{\beta} * X_{i, k}$
where $B i d A s k_{i}$ represents the bid-ask measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $A A_{i}$ is one if bond i is AA-rated and zero otherwise, $A_{i}$ is one if bond i is A-rated and zero otherwise, $B B B+{ }_{i}$ is one if bond i is $\mathrm{BBB}+$-rated and zero otherwise. $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Insurance effect | $0.00163^{* * *}$ | $0.00262^{* * *}$ | $0.00153^{* * *}$ | $0.00205^{* * *}$ | $0.00150^{* * *}$ |
|  | $(0.000283)$ | $(0.000708)$ | $(0.000318)$ | $(0.000472)$ | $(0.000406)$ |
| Log(maturity) | $0.00293^{* * *}$ | $0.00139^{* * *}$ | $0.00310^{* * *}$ | $0.00266^{* * *}$ | $0.00310^{* * *}$ |
|  | $(9.47 \mathrm{e}-05)$ | $(0.000199)$ | $(0.000104)$ | $(0.000130)$ | $(0.000135)$ |
| Size dummy | $0.00159^{* * *}$ | $0.00189^{* * *}$ | $0.00137^{* * *}$ | $0.00166^{* * *}$ | $0.00135^{* * *}$ |
|  | $(9.37 \mathrm{e}-05)$ | $(0.000191)$ | $(0.000104)$ | $(0.000125)$ | $(0.000126)$ |
| Time outstanding | $0.00140^{* * *}$ | 0.000454 | $0.00134^{* * *}$ | $0.00150^{* * *}$ | $0.00124^{* * *}$ |
|  | $(0.000116)$ | $(0.000618)$ | $(0.000127)$ | $(0.000197)$ | $(0.000151)$ |
| Log(issue size) | 0.000145 | $-4.81 \mathrm{e}-05$ | 0.000204 | $4.59 \mathrm{e}-05$ | 0.000112 |
|  | $(0.000125)$ | $(0.000268)$ | $(0.000140)$ | $(0.000178)$ | $(0.000177)$ |
| Log(bond size) | $0.00139^{* * *}$ | $0.000466^{* * *}$ | $0.00149^{* * *}$ | $0.000577^{* * *}$ | $0.00166^{* * *}$ |
|  | $(7.86 \mathrm{e}-05)$ | $(0.000130)$ | $(8.47 \mathrm{e}-05)$ | $(9.37 \mathrm{e}-05)$ | $(0.000106)$ |
| Offering dummy | $0.00110^{* * *}$ | $0.00237^{* * *}$ | $0.000881^{* *}$ | $0.000955^{* *}$ | $0.000765^{*}$ |
|  | $(0.000320)$ | $(0.000798)$ | $(0.000367)$ | $(0.000482)$ | $(0.000428)$ |
| Constant | $-0.0287^{* * *}$ | $-0.00941^{*}$ | $-0.0303^{* * *}$ | $-0.0142^{* * *}$ | $-0.0290^{* * *}$ |
|  | $(0.00237)$ | $(0.00528)$ | $(0.00266)$ | $(0.00336)$ | $(0.00347)$ |
| Observations |  |  |  |  | 24,321 |
| R-squared | 71,277 | 8,885 | 62,392 | 0.323 | 46,956 |
|  | 0.271 | 0.344 | 0.261 | 0.270 |  | R-squared

Table 4.44: The average effect of each insurer on liquidity as measured by the bid-ask measure with issuer fixed effects, time fixed effects and controls
This table shows results from the ordinary least squares regression of the bid-ask measure on an dummy for each insurer

## BidAsk $_{i}=\beta_{1} *$ Ambac $+\beta_{2} *$ Assured $+\beta_{3} * M B I A+\underline{\beta} * X_{i, k}$

$$
+\beta_{\text {Issuer }} * \gamma_{\text {Issuer }}+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i}
$$

where $B i d A s k_{i}$ represents the bid-ask measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Ambac effect | $0.00119^{* * *}$ | 0.00105 | $0.00124^{* * *}$ | $0.00161^{* * *}$ | $0.00146^{* *}$ |
|  | $(0.000391)$ | $(0.000671)$ | $(0.000431)$ | $(0.000430)$ | $(0.000583)$ |
| MBIA effect | $0.00119^{* * *}$ | 0.000922 | $0.00115^{* * *}$ | $0.00128^{* * *}$ | $0.00122^{* *}$ |
|  | $(0.000306)$ | $(0.000688)$ | $(0.000378)$ | $(0.000379)$ | $(0.000564)$ |
| Assured effect | $0.00127^{* * *}$ | 0.000711 | $0.00128^{* * *}$ | $0.00123^{* * *}$ | $0.00109^{* * *}$ |
|  | $(0.000269)$ | $(0.000554)$ | $(0.000316)$ | $(0.000363)$ | $(0.000416)$ |
| Log(maturity) | $0.00296^{* * *}$ | $0.00144^{* * *}$ | $0.00315^{* * *}$ | $0.00263^{* * *}$ | $0.00318^{* * *}$ |
|  | $(8.98 \mathrm{e}-05)$ | $(0.000172)$ | $(0.000101)$ | $(0.000117)$ | $(0.000131)$ |
| Size dummy | $0.00161^{* * *}$ | $0.00187^{* * *}$ | $0.00138^{* * *}$ | $0.00169^{* * *}$ | $0.00135^{* * *}$ |
|  | $(8.79 \mathrm{e}-05)$ | $(0.000167)$ | $(9.90 \mathrm{e}-05)$ | $(0.000112)$ | $(0.000122)$ |
| Time outstanding | $0.00127^{* * *}$ | 0.000628 | $0.00119^{* * *}$ | $0.00146^{* * *}$ | $0.00108^{* * *}$ |
|  | $(0.000107)$ | $(0.000558)$ | $(0.000120)$ | $(0.000180)$ | $(0.000145)$ |
| Log(issue size) | $7.09 \mathrm{e}-05$ | $-5.63 \mathrm{e}-05$ | 0.000117 | $-6.09 \mathrm{e}-06$ | $4.74 \mathrm{e}-07$ |
|  | $(0.000121)$ | $(0.000274)$ | $(0.000138)$ | $(0.000168)$ | $(0.000175)$ |
| Log(bond size) | $0.00137^{* * *}$ | $0.000478^{* * *}$ | $0.00147^{* * *}$ | $0.000586^{* * *}$ | $0.00164^{* * *}$ |
|  | $(7.50 \mathrm{e}-05)$ | $(0.000116)$ | $(8.21 \mathrm{e}-05)$ | $(8.71 \mathrm{e}-05)$ | $(0.000101)$ |
| Constant | $-0.0266^{* * *}$ | -0.00853 | $-0.0285^{* * *}$ | $-0.0130^{* * *}$ | $-0.0265^{* * *}$ |
| Observations | $(0.00233)$ | $(0.00545)$ | $(0.00262)$ | $(0.00318)$ | $(0.00337)$ |
| R-squared | 79,387 | 11,285 | 68,102 | 29,073 | 50,314 |

Table 4.45: Average difference in Bid-Ask measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bonds with a AA pure rating
This table shows results from the ordinary least squares regression of the Bid-Ask measure on an insured dummy
where $B_{i d A s k_{i}}$ represents the bid-ask measure for municipal bond i , Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | $0.00170^{* * *}$ |
| Insurance effect | $0.00150^{* * *}$ | 0.000589 | $0.00153^{* * *}$ | $0.000894^{* *}$ | $(0.000390)$ |
|  | $(0.000275)$ | $(0.000620)$ | $(0.000311)$ | $0.000441)$ | $\left(0.0000^{* * *}\right.$ |
| Log(maturity) | $0.00284^{* * *}$ | $0.00117^{* * *}$ | $0.00298^{* * *}$ | $0.00262^{* * *}$ | $(0.000186)$ |
| Size dummy | $(0.000116)$ | $(0.000274)$ | $(0.000123)$ | $0.00147^{* * *}$ |  |
|  | $0.00171^{* * *}$ | $0.00227^{* * *}$ | $0.00149^{* * *}$ | $(0.000165)$ |  |
| Time outstanding | $(0.000129)$ | $(0.000271)$ | $(0.000144)$ | $(0.000187)$ | $0.00110^{* * *}$ |
|  | $0.00139^{* * *}$ | 0.00120 | $0.00130^{* * *}$ | $0.00180^{* * *}$ | $(0.000178)$ |
| Log(issue size) | $(0.000143)$ | $(0.000884)$ | $(0.000153)$ | $-6.08 \mathrm{e}-05$ |  |
|  | $-5.33 \mathrm{e}-05$ | 0.000619 | $-8.29 \mathrm{e}-05$ | $(0.000295)$ | $0.000388^{*}$ |
| Log(bond size) | $(0.000142)$ | $(0.000399)$ | $(0.000162)$ | $(0.000211)$ | $0.000207)$ |
|  | $0.00135^{* * *}$ | $0.000648^{* * *}$ | $0.00147^{* * *}$ | $0.000576^{* * *}$ | $(0.000135)$ |
| Offering dummy | $(0.000102)$ | $(0.000184)$ | $(0.000113)$ | $0.00171^{* *}$ | $(0.000150)$ |
| Constant | $0.00234^{* * *}$ | $0.00220^{* *}$ | $0.00239^{* * *}$ | $0.00212^{* * *}$ |  |
|  | $(0.000363)$ | $(0.00107)$ | $(0.000414)$ | $(0.000686)$ | $(0.000481)$ |
| Observations | $-0.0267^{* * *}$ | $-0.0243^{* * *}$ | $-0.0262^{* * *}$ | $-0.0212^{* * *}$ | $-0.0300^{* * *}$ |
| R-squared | $(0.00293)$ | $(0.00695)$ | $(0.00340)$ | $(0.00368)$ | $(0.00471)$ |

Table 4.46: Average difference in Bid-Ask measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bonds with a A pure rating
This table shows results from the ordinary least squares regression of the Bid-Ask measure on an insured dummy
where $B_{i d A s k_{i}}$ represents the bid-ask measure for municipal bond i , Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | $0.00192^{*}$ |
| Insurance effect | $0.00225^{* * *}$ | $0.00428^{* * *}$ | $0.00214^{* * *}$ | $0.00332^{* * *}$ | $(0.00102)$ |
|  | $(0.000754)$ | $(0.00161)$ | $(0.000801)$ | $(0.000970)$ | $0.00361^{* * *}$ |
| Log(maturity) | $0.00313^{* * *}$ | $0.000868^{* *}$ | $0.00341^{* * *}$ | $0.00231^{* * *}$ | $(0.000395)$ |
|  | $(0.000284)$ | $(0.000370)$ | $(0.000313)$ | $0.00105^{* * *}$ |  |
| Size dummy | $0.00126^{* * *}$ | $0.00129^{* * *}$ | $0.00103^{* * *}$ | $0.00127^{* * *}$ | $(0.000285)$ |
| Time outstanding | $(0.000208)$ | $(0.000410)$ | $(0.000228)$ | $(0.000233)$ | $0.00146^{* * *}$ |
|  | $0.00128^{* * *}$ | 0.000594 | $0.00127^{* * *}$ | $0.000768^{*}$ | $(0.000499)$ |
| Log(issue size) | $(0.000364)$ | $(0.00118)$ | $(0.000404)$ | $(0.000439)$ | -0.000447 |
|  | $4.55 \mathrm{e}-05$ | 0.000514 | $-1.77 \mathrm{e}^{-05}$ | $-2.43 \mathrm{e}^{-05}$ | $(0.000348)$ |
| Log(bond size) | $(0.000329)$ | $(0.000597)$ | $(0.000353)$ | $0.000693^{* * *}$ | $0.00188^{* * *}$ |
|  | $0.00155^{* * *}$ | $0.000606^{* *}$ | $0.00160^{* * *}$ | $(0.000188)$ | $(0.000247)$ |
| Offering dummy | $(0.000193)$ | $(0.000270)$ | $(0.000204)$ | -0.000163 | $(0.00121)$ |
| Constant | -0.00114 | 0.00172 | $-0.00181^{*}$ | $(0.000969)$ | $-0.00102)$ |
|  | $(0.000859)$ | $(0.00194)$ | $-0.0286^{* * *}$ | $(0.00676)$ | $-0.0245^{* * *}$ |
| Observations | $-0.0273^{* * *}$ | $-0.0260^{* *}$ | $(0.00561)$ | $(0.00718)$ |  |
| R-squared | $(0.00538)$ | $(0.0120)$ |  | 17,518 | 7,180 |

Table 4.47: Average difference in Bid-Ask measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bonds with a AAA actual rating
This table shows results from the ordinary least squares regression of the Bid-Ask measure on an insured dummy
where $B_{i d A s k}$ represents the bid-ask measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insurance effect | 0.000876 | 0.000774 | 0.000652 | 0.00249** | 0.000194 |
|  | (0.000780) | (0.00195) | (0.000881) | (0.00109) | (0.00105) |
| Log(maturity) | $0.00307^{* * *}$ | $0.00149^{* * *}$ | $0.00322^{* * *}$ | $0.00272^{* * *}$ | $0.00322^{* * *}$ |
|  | (0.000141) | (0.000413) | (0.000156) | (0.000232) | (0.000188) |
| Size dummy | $0.00117^{* * *}$ | $0.00124^{* * *}$ | $0.00105^{* * *}$ | $0.000855^{* * *}$ | $0.00125^{* * *}$ |
|  | (0.000149) | (0.000353) | (0.000165) | (0.000193) | (0.000214) |
| Time outstanding | $0.00113^{* * *}$ | -8.32e-05 | $0.00119^{* * *}$ | $0.000818^{* * *}$ | $0.00119^{* * *}$ |
|  | (0.000138) | (0.000869) | (0.000152) | (0.000276) | (0.000175) |
| Log(issue size) | -7.02e-05 | -0.00104* | 0.000222 | -0.000935*** | 0.000463 |
|  | (0.000223) | (0.000589) | (0.000254) | (0.000326) | (0.000314) |
| Log(bond size) | $0.000962^{* * *}$ | 0.000270 | 0.000973 *** | $0.000587^{* * *}$ | $0.00115^{* * *}$ |
|  | (0.000117) | (0.000274) | (0.000130) | (0.000163) | (0.000173) |
| Offering dummy | $0.00157^{* * *}$ | $0.00357^{* *}$ | $0.00131^{* * *}$ | 0.00149* | $0.00193 * * *$ |
|  | (0.000443) | (0.00164) | (0.000489) | (0.000780) | (0.000602) |
| Constant | $-0.0171^{* * *}$ | 0.0134 | $-0.0234^{* * *}$ | 0.00546 | $-0.0284^{* * *}$ |
|  | (0.00423) | (0.0112) | (0.00469) | (0.00602) | (0.00580) |
| Observations | 27,234 | 3,413 | 23,821 | 10,867 | 16,367 |
| R-squared | 0.229 | 0.383 | 0.221 | 0.304 | 0.227 |

Table 4.48: Average difference in Bid-Ask measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bonds with a AA actual rating
This table shows results from the ordinary least squares regression of the Bid-Ask measure on an insured dummy
where $B_{i d A s k}$ represents the bid-ask measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insurance effect | $0.00135^{* * *}$ | -0.000701 | $0.00157^{* * *}$ | -0.000112 | $0.00177^{* * *}$ |
|  | (0.000384) | (0.000524) | (0.000450) | (0.000540) | (0.000569) |
| Log(maturity) | $0.00270^{* * *}$ | $0.000913^{* * *}$ | $0.00289^{* * *}$ | $0.00243^{* * *}$ | $0.00277^{* * *}$ |
|  | (0.000122) | (0.000265) | (0.000126) | (0.000198) | (0.000139) |
| Size dummy | $0.00182^{* * *}$ | $0.00160^{* * *}$ | $0.00165^{* * *}$ | $0.00174^{* * *}$ | $0.00158^{* * *}$ |
|  | (0.000135) | (0.000262) | (0.000148) | (0.000213) | (0.000169) |
| Time outstanding | $0.00152^{* * *}$ | 0.000766 | $0.00139^{* * *}$ | $0.00242^{* * *}$ | $0.00120^{* * *}$ |
|  | (0.000151) | (0.00117) | (0.000164) | (0.000368) | (0.000192) |
| Log(issue size) | -4.84e-05 | 0.000345 | -8.50e-05 | 0.000144 | -4.33e-05 |
|  | (0.000162) | (0.000318) | (0.000183) | (0.000208) | (0.000220) |
| Log(bond size) | $0.00144^{* * *}$ | 0.000349* | $0.00154^{* * *}$ | $0.000441^{* * *}$ | $0.00170^{* * *}$ |
|  | (0.000121) | (0.000180) | (0.000127) | (0.000144) | (0.000134) |
| Offering dummy | $0.00191^{* * *}$ | $0.00258^{* *}$ | $0.00185^{* * *}$ | $0.00151^{* *}$ | $0.00187^{* * *}$ |
|  | (0.000396) | (0.00117) | (0.000449) | (0.000678) | (0.000519) |
| Constant | $-0.0275^{* * *}$ | -0.0132** | $-0.0266^{* * *}$ | $-0.0138^{* * *}$ | $-0.0300^{* * *}$ |
|  | (0.00343) | (0.00556) | (0.00383) | (0.00367) | (0.00448) |
| Observations | 28,247 | 3,374 | 24,873 | 8,008 | 20,239 |
| R-squared | 0.303 | 0.327 | 0.294 | 0.342 | 0.296 |

Table 4.49: Average difference in Bid-Ask measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bonds with a $\mathbf{A}$ actual rating
This table shows results from the ordinary least squares regression of the Bid-Ask measure on an insured dummy
where $B_{i d A s k}$ represents the bid-ask measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | 0.00133 |
| Insurance effect | $0.00156^{* *}$ | 0.00164 | $0.00167^{* *}$ | $0.00189^{* * *}$ | $(0.00114)$ |
|  | $(0.000768)$ | $(0.00120)$ | $(0.000829)$ | $0.00360^{* * *}$ |  |
| Log(maturity) | $0.00316^{* * *}$ | $0.00100^{* * *}$ | $0.00344^{* * *}$ | $0.00197^{* * *}$ | $(0.000431)$ |
|  | $(0.000322)$ | $(0.000323)$ | $(0.000354)$ | $(0.000281)$ | $0.00123^{* * *}$ |
| Size dummy | $0.00137^{* * *}$ | $0.000937^{* *}$ | $0.00122^{* * *}$ | $0.00126^{* * *}$ | $(0.000339)$ |
| Time outstanding | $(0.000249)$ | $(0.000393)$ | $(0.000274)$ | $(0.000282)$ | $0.00191^{* * *}$ |
|  | $0.00191^{* * *}$ | 0.00221 | $0.00185^{* * *}$ | $0.00136^{* *}$ | $(0.000554)$ |
| Log(issue size) | $(0.000411)$ | $(0.00158)$ | $(0.000447)$ | $(0.000572)$ | -0.000370 |
|  | 0.000195 | 0.000284 | 0.000145 | 0.000385 | $(0.000554)$ |
| Log(bond size) | $(0.000397)$ | $(0.000499)$ | $(0.000433)$ | $0.000370)$ | $0.00182^{* * *}$ |
|  | $0.00148^{* * *}$ | 0.000133 | $0.00154^{* * *}$ | $0.000708^{* * *}$ | $(0.000277)$ |
| Offering dummy | $(0.000215)$ | $(0.000212)$ | $(0.000231)$ | $(0.000185)$ | $-0.00422^{* * *}$ |
| Constant | $-0.00176^{*}$ | -0.000234 | $-0.00217^{*}$ | $(0.00116)$ | $(0.00128)$ |
|  | $(0.00102)$ | $(0.00148)$ | $-0.0301^{* * *}$ | $-0.0220^{* * *}$ | $(0.00722)$ |
| Observations | $-0.0319^{* * *}$ | -0.0126 | $(0.00726)$ | $-0.0261^{* * *}$ | $(0.00895)$ |
| R-squared | $(0.00654)$ | $(0.00991)$ |  | 12,356 | 4,670 |

Table 4.50: Effect of change in insurance status on the Bid-Ask measure with time controls
This table shows results from the difference in difference regression below:

$$
\begin{aligned}
\text { BidAsk }_{i, j} & =\beta_{1} * \text { Insured }+\beta_{2} * \text { PreEvent } * \text { Insured }+\beta_{3} * \text { PreEvent }+\underline{\beta} * X_{i, j} \\
& +\beta * X_{i, j} * \text { PreEvent }+\beta_{s} * \gamma_{s} * \text { PreEvent }+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i, j}
\end{aligned}
$$

where $\operatorname{BidAsk}_{i, j}$ represents the bid-ask measure for municipal bond i, issued by issuer j. PreEvent is 1 if date of measure is before the give event, and $X_{i, j}$ is a vector of k standard controls, Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, and $\epsilon_{i}$ is an error term. Each specification, is a different event. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is run using the stock price drop of the insurers as the event. Specification 2 is run using the downgrade of the insurers as the event.

|  | Stock Drop | Ratings Downgrade |
| :--- | :---: | :---: |
| insuredpartial |  |  |
|  | $-0.000463^{*}$ | $1.90 \mathrm{e}-05$ |
| predowngrade | $(0.000270)$ | $-0.000333)$ |
|  |  | $(0.0000526)$ |
| prestock | $0.0183^{* * *}$ |  |
|  | $(0.00202)$ | $0.00156^{* * *}$ |
| Insurance effect | $0.00161^{* * *}$ | $(0.000321)$ |
|  | $(0.000244)$ | $0.00278^{* * *}$ |
| Log(maturity) | $0.00294^{* * *}$ | $(9.16 \mathrm{e}-05)$ |
|  | $(9.99 \mathrm{e}-05)$ | $0.00182^{* * *}$ |
| Size dummy | $0.00161^{* * *}$ | $(8.94 \mathrm{e}-05)$ |
|  | $(9.88 \mathrm{e}-05)$ | $0.00122^{* * *}$ |
| Time outstanding | $0.00114^{* * *}$ | $(9.52 \mathrm{e}-05)$ |
|  | $(8.94 \mathrm{e}-05)$ | $0.000174^{* * *}$ |
| Log(issue size) | $0.000177^{* *}$ | $(6.68 \mathrm{e}-05)$ |
|  | $(7.38 \mathrm{e}-05)$ | $0.00179^{* * *}$ |
| Log(bond size) | $0.00189^{* * *}$ | $(9.06 \mathrm{e}-05)$ |
| Offering dummy | $(9.73 \mathrm{e}-05)$ | $0.00128^{* * *}$ |
|  | $0.00128^{* * *}$ | $(0.000128)$ |
| Constant | $(0.000129)$ | $-0.0361^{* * *}$ |
|  | $-0.0399^{* * *}$ | $(0.00160)$ |
| Observations | $(0.00160)$ | 71,277 |
| R-squared |  | 0.228 |

Table 4.51: Effect of change in insurance status on the Bid-Ask measure with time controls, issuer controls, underlying rating dummies, and controls
This table shows results from the difference in difference regression below:

$$
\begin{aligned}
\text { BidAsk }_{i, j} & =\beta_{1} * \text { Insured }+\beta_{2} * \text { PreEvent } * \text { Insured }+\beta_{3} * \text { PreEvent }+\underline{\beta} * X_{i, j} \\
& +\beta * X_{i, j} * \text { PreEvent }+\beta_{s} * \gamma_{s} * \text { PreEvent }+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i, j}
\end{aligned}
$$

where BidAsk $_{i, j}$ represents the turnover measure for municipal bond i, issued by issuer j. PreEvent is 1 if date of measure is before the give event, and $X_{i, j}$ is a vector of k standard controls, Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, and $\epsilon_{i}$ is an error term. Each specification, is a different event. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is run using the stock price drop of the insurers as the event. Specification 2 is run using the downgrade of the insurers as the event.

|  | Stock Drop | Ratings Downgrade |
| :--- | :---: | :---: |
|  |  |  |
| insuredpartial | -0.000253 | $-7.72 \mathrm{e}-05$ |
|  | $(0.000400)$ | $(0.000366)$ |
| Insurance effect | $0.00173^{* * *}$ | $0.00175^{* * *}$ |
|  | $(0.000298)$ | $(0.000356)$ |
| Log(maturity) | $0.00312^{* * *}$ | $\left(0.0316^{* * *}\right.$ |
|  | $(0.000102)$ | $0.00142^{* * *}$ |
| Size dummy | $0.00139^{* * *}$ | $(0.000123)$ |
|  | $(0.000103)$ | $0.00112^{* * *}$ |
| Time outstanding | $0.00127^{* * *}$ | $(0.000122)$ |
|  | $(0.000120)$ | $3.33 \mathrm{e}-05$ |
| Log(issue size) | 0.000145 | $(0.000140)$ |
|  | $(0.000131)$ | $0.00176^{* * *}$ |
| Log(bond size) | $0.00150^{* * *}$ | $(0.000105)$ |
|  | $(8.43 \mathrm{e}-05)$ | $0.000956^{* * *}$ |
| Offering dummy | $0.00110^{* * *}$ | $(0.000321)$ |
| Constant | $(0.000321)$ | $-0.0155^{* * *}$ |
|  | $-0.0138^{* * *}$ | $(0.00239)$ |
| Observations | $(0.00272)$ |  |
| R-squared |  | 71,277 |

Table 4.52: Average difference in Bid-Ask measure between AAA-rated and non AAA-rated municipal bonds with issuer fixed effects, time fixed effects and controls
This table shows results from the ordinary least squares regression of the Bid-Ask measure on a AAA dummy

## Bidask $_{i}=\beta_{1} * A A A+\beta * X_{i, k}+\beta_{\text {Issuer }} * \gamma_{\text {Issuer }}+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i}$

where $\operatorname{BidAsk} k_{i}$ represents the Bid-Ask measure for municipal bond i, AAA is one if bond i has an actual rating of AAA and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| AAA effect | $0.00126^{* * *}$ | $0.00445^{* * *}$ | $0.000884^{* * *}$ | $0.00309^{* * *}$ | $0.000466$ |
| Log(maturity) | (0.000278) <br> $0.00292^{* * *}$ <br> (9.45e-05) | (0.000435) $0.00124^{* * *}$ (0.000199) | (0.000324) $0.00310^{* * *}$ (0.000104) | $\begin{gathered} (0.000286) \\ 0.00255^{* * *} \end{gathered}$ (0.000129) | $\begin{aligned} & (0.000426) \\ & 0.00312^{* * *} \end{aligned}$ |
| Size dummy | $\begin{gathered} 0.00158^{* * *} \\ (9.33 \mathrm{e}-05) \end{gathered}$ | $\begin{aligned} & 0.00156^{* * *} \\ & (0.000187) \end{aligned}$ | $\begin{aligned} & 0.00138^{* * *} \\ & (0.000103) \end{aligned}$ | $\begin{gathered} 0.00149^{* * *} \\ (0.000127) \end{gathered}$ | $\begin{gathered} 0.00138^{* * *} \\ (0.000126) \end{gathered}$ |
| Time outstanding | $\begin{gathered} 0.00156^{* * *} \\ (0.000109) \end{gathered}$ | $\begin{gathered} 0.000123 \\ (0.000611) \end{gathered}$ | $\begin{gathered} 0.00152^{* * *} \\ (0.000116) \end{gathered}$ | $\begin{gathered} 0.00144^{* * *} \\ (0.000193) \end{gathered}$ | $\begin{gathered} 0.00144^{* * *} \\ (0.000131) \end{gathered}$ |
| $\log$ (issue size) | $\begin{gathered} 0.000186 \\ (0.000127) \end{gathered}$ | $\begin{gathered} 1.04 \mathrm{e}-05 \\ (0.000298) \end{gathered}$ | $\begin{aligned} & 0.000239^{*} \\ & (0.000141) \end{aligned}$ | $\begin{gathered} 0.000138 \\ (0.000175) \end{gathered}$ | $\begin{gathered} 0.000158 \\ (0.000179) \end{gathered}$ |
| Log(bond size) | $\begin{gathered} 0.00136^{* * *} \\ (8.02 \mathrm{e}-05) \end{gathered}$ | $\begin{gathered} 0.000312^{* *} \\ (0.000129) \end{gathered}$ | $\begin{gathered} 0.00146^{* * *} \\ (8.56 \mathrm{e}-05) \end{gathered}$ | $\begin{gathered} 0.000472^{* * *} \\ (9.49 \mathrm{e}-05) \end{gathered}$ | $\begin{gathered} 0.00165^{* * *} \\ (0.000107) \end{gathered}$ |
| Offering dummy | $\begin{gathered} 0.000936^{* * *} \\ (0.000332) \end{gathered}$ | $\begin{gathered} 0.00252^{* * *} \\ (0.000833) \end{gathered}$ | $\begin{aligned} & 0.000668^{*} \\ & (0.000379) \end{aligned}$ | $\begin{aligned} & 0.00112^{* *} \\ & (0.000511) \end{aligned}$ | $\begin{gathered} 0.000538 \\ (0.000435) \end{gathered}$ |
| Constant | $\begin{gathered} -0.0290^{* * *} \\ (0.00233) \end{gathered}$ | $\begin{aligned} & -0.00863 \\ & (0.00545) \end{aligned}$ | $\begin{gathered} -0.0309^{* * *} \\ (0.00260) \end{gathered}$ | $\begin{gathered} -0.0139^{* * *} \\ (0.00311) \end{gathered}$ | $\begin{gathered} -0.0327^{* * *} \\ (0.00326) \end{gathered}$ |
| Observations | 71,277 | 8,885 | 62,392 | 24,321 | 46,956 |
| R -squared | 0.271 | 0.362 | 0.260 | 0.329 | 0.269 |

Table 4.53: Average difference in Turnover measure between insured and uninsured municipal bonds with controls and time fixed effects
This table shows results from the ordinary least squares regression of the Turnover measure on an insured dummy, controls and time fixed effects
where Turnover $_{i}$ represents the Turnover liquidity measure for municipal bond i, Insured is one if bond is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009. $-0.00302^{* * *}$ (0.000313) $0.139^{* * *}$
$(0.00419)$






(0.000424) $-0.0161^{* * *}$ (0.000360) $0.0102^{* * *}$ (0.000318) O (0.000400) $0.167^{* * *}$
$(0.00370)$ 140,914
0.210
Full Sample

$$
\begin{gathered}
-0.00330^{* * *} \\
(0.000239)
\end{gathered}
$$

-0.000183
(0.000275) $-0.0198^{* * *}$ (0.000215) $-0.00325^{* *}$ (0.000103) $-0.0115^{*}$ (0.000216) (0.000138) $-0.00397^{* * *}$ (0.000247) $*$
$\stackrel{3}{*}$
$\stackrel{0}{*}$
$\stackrel{\circ}{4}$
0
0 995,482
0.049 Insurance effect $\log$ (maturity) Size dumay
Size dummy
Time outstanding
$\log ($ issue size $)$
Log(bond size)
Offering dummy
Constant

## Observations R-squared

$$
\begin{aligned}
& 0.140^{* * *} \\
& (0.00342)
\end{aligned}
$$

$$
854,568
$$

Table 4.54: Average difference in Turnover measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls
This table shows results from the ordinary least squares regression of the Turnover measure on an insured dummy
Turnover $_{i}=\beta_{1} *$ Insured $+\underline{\beta} * X_{i, k}+\beta_{\text {Issuer }} * \gamma_{\text {Issuer }}+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i}$
where Turnover $_{i}$ represents the Turnover measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | $-0.00107^{* * *}$ |
| Insurance effect | $-0.00130^{* * *}$ | $-0.00668^{* * *}$ | $-0.00119^{* * *}$ | $-0.00384^{* * *}$ | $(0.000256)$ |
|  | $(0.000317)$ | $(0.000974)$ | $(0.000327)$ | $(0.000809)$ | $-0.000933^{* * *}$ |
| Log(maturity) | 0.000175 | $0.00493^{* * *}$ | -0.000250 | $0.00354^{* * *}$ | $(0.000308)$ |
|  | $(0.000253)$ | $(0.000292)$ | $(0.000277)$ | $-0.0146^{* * *}$ |  |
| Size dummy | $-0.0177^{* * *}$ | $-0.0210^{* * *}$ | $-0.0163^{* * *}$ | $-0.0214^{* * *}$ | $(0.000239)$ |
| Time outstanding | $(0.000196)$ | $(0.000287)$ | $(0.000215)$ | $-0.000259)$ | $-0.00253^{* * *}$ |
|  | $-0.00273^{* * *}$ | $-0.00432^{* * *}$ | $-0.00266^{* * *}$ | $-0.00417^{* * *}$ | $(0.000389)$ |
| Log(issue size) | $(0.000107)$ | $(0.000519)$ | $(0.000110)$ | $-0.0134^{* * *}$ | $-0.00981^{* * *}$ |
|  | $-0.0111^{* * *}$ | $-0.0155^{* * *}$ | $-0.0103^{* * *}$ | $(0.000484)$ | $(0.000247)$ |
| Log(bond size) | $(0.000250)$ | $(0.000725)$ | $(0.000242)$ | $0.00504^{* * *}$ |  |
|  | $0.00637^{* * *}$ | $0.0115^{* * *}$ | $0.00558^{* * *}$ | $\left(0.00917^{* * *}\right.$ | $(0.000300)$ |
| Offering dummy | $(0.000153)$ | $(0.000390)$ | $(0.000156)$ | $-0.00562^{* * *}$ | $-0.00389^{* * *}$ |
| Constant | $-0.00453^{* * *}$ | $-0.00842^{* * *}$ | $-0.00386^{* * *}$ | $(0.000966)$ | $(0.000384)$ |
|  | $(0.000427)$ | $(0.00139)$ | $(0.000461)$ | $0.140^{* * *}$ | $0.131^{* * *}$ |
| Observations | $0.141^{* * *}$ | $0.145^{* * *}$ | $0.129^{* * *}$ | $(0.00668)$ | $(0.00371)$ |
| R-squared | $(0.00371)$ | $(0.0108)$ | $(0.00352)$ |  |  |

Table 4.55: Average difference in Turnover measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects, underlying rating dummies and controls
This table shows results from the ordinary least squares regression of the Turnover measure on an insured dummy
Turnover $_{i}=\beta_{1} *$ Insured $+\beta_{2} * A A_{i}+\beta_{3} * A_{i}+\beta_{4} * B B B+{ }_{i}+\underline{\beta} * X_{i, k}$
where Turnover $_{i}$ represents the Turnover measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $A A_{i}$ is one if bond i is AA-rated and zero otherwise, $A_{i}$ is one if bond i is A-rated and zero otherwise, $B B B+{ }_{i}$ is one if bond i is $\mathrm{BBB}+$-rated and zero otherwise. $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Insurance effect | $-0.00140^{* * *}$ | $-0.00693^{* * *}$ | $-0.00122^{* * *}$ | $-0.00383^{* * *}$ | $-0.00110^{* * *}$ |
|  | $(0.000322)$ | $(0.00102)$ | $(0.000333)$ | $(0.000824)$ | $(0.000260)$ |
| Log(maturity) | 0.000176 | $0.00494^{* * *}$ | -0.000248 | $0.00355^{* * *}$ | $-0.000934^{* * *}$ |
|  | $(0.000253)$ | $(0.000292)$ | $(0.000277)$ | $(0.000382)$ | $(0.000308)$ |
| Size dummy | $-0.0177^{* * *}$ | $-0.0210^{* * *}$ | $-0.0163^{* * *}$ | $-0.0214^{* * *}$ | $-0.0146^{* * *}$ |
|  | $(0.000196)$ | $(0.000287)$ | $(0.000215)$ | $(0.000259)$ | $(0.000239)$ |
| Time outstanding | $-0.00273^{* * *}$ | $-0.00437^{* * *}$ | $-0.00267^{* * *}$ | $-0.00416^{* * *}$ | $-0.00252^{* * *}$ |
|  | $(0.000107)$ | $(0.000520)$ | $(0.000111)$ | $(0.000389)$ | $(8.32 \mathrm{e}-05)$ |
| Log(issue size) | $-0.0111^{* * *}$ | $-0.0154^{* * *}$ | $-0.0102^{* * *}$ | $-0.0133^{* * *}$ | $-0.00980^{* * *}$ |
|  | $(0.000251)$ | $(0.000722)$ | $(0.000243)$ | $(0.000483)$ | $(0.000249)$ |
| Log(bond size) | $0.00638^{* * *}$ | $0.0116^{* * *}$ | $0.00558^{* * *}$ | $0.00917^{* * *}$ | $0.00504^{* * *}$ |
|  | $(0.000153)$ | $(0.000391)$ | $(0.000156)$ | $(0.000300)$ | $(0.000162)$ |
| Offering dummy | $-0.00448^{* * *}$ | $-0.00810^{* * *}$ | $-0.00384^{* * *}$ | $-0.00544^{* * *}$ | $-0.00388^{* * *}$ |
| Constant | $(0.000426)$ | $(0.00140)$ | $(0.000460)$ | $(0.000967)$ | $(0.000385)$ |
|  | $0.140^{* * *}$ | $0.142^{* * *}$ | $0.129^{* * *}$ | $0.138^{* * *}$ | $0.130^{* * *}$ |
| Observations | $(0.00380)$ | $(0.0108)$ | $(0.00365)$ | $(0.00678)$ | $(0.00384)$ |
| R-squared |  |  |  |  | 322,943 |

Table 4.56: The average effect of each insurer on liquidity as measured by the Turnover measure with issuer fixed effects, time fixed effects and controls
This table shows results from the ordinary least squares regression of the Turnover measure on an dummy for each insurer
Turnover $_{i}=\beta_{1} *$ Ambac $+\beta_{2} *$ Assured $+\beta_{3} * M B I A+\underline{\beta} * X_{i, k}$
where Turnover $_{i}$ represents the spread to treasury for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Ambac effect | $-0.00158^{* * *}$ | $-0.00372^{* * *}$ | $-0.00137^{* * *}$ | $-0.00432^{* * *}$ | $-0.000808^{* * *}$ |
|  | $(0.000378)$ | $(0.00121)$ | $(0.000378)$ | $(0.000990)$ | $(0.000295)$ |
| MBIA effect | $-0.00361^{* * *}$ | $-0.00493^{* * *}$ | $-0.00381^{* * *}$ | $-0.00660^{* * *}$ | $-0.00309^{* * *}$ |
|  | $(0.000413)$ | $(0.00129)$ | $(0.000431)$ | $(0.00120)$ | $(0.000300)$ |
| Assured effect | $-0.00148^{* * *}$ | $-0.00297^{* * *}$ | $-0.00149^{* * *}$ | $-0.00339^{* * *}$ | $-0.00135^{* * *}$ |
|  | $(0.000353)$ | $(0.00104)$ | $(0.000394)$ | $(0.00106)$ | $(0.000257)$ |
| Log(maturity) | 0.000270 | $0.00507^{* * *}$ | -0.000183 | $0.00342^{* * *}$ | $-0.000868^{* * *}$ |
|  | $(0.000220)$ | $(0.000255)$ | $(0.000242)$ | $(0.000309)$ | $(0.000274)$ |
| Size dummy | $-0.0177^{* * *}$ | $-0.0212^{* * *}$ | $-0.0161^{* * *}$ | $-0.0215^{* * *}$ | $-0.0142^{* * *}$ |
|  | $(0.000174)$ | $(0.000249)$ | $(0.000192)$ | $(0.000227)$ | $(0.000216)$ |
| Time outstanding | $-0.00262^{* * *}$ | $-0.00449^{* * *}$ | $-0.00252^{* * *}$ | $-0.00429^{* * *}$ | $-0.00243^{* * *}$ |
|  | $(0.000104)$ | $(0.000445)$ | $(0.000111)$ | $(0.000284)$ | $(7.73 \mathrm{e}-05)$ |
| Log(bond size) | $0.00622^{* * *}$ | $0.0115^{* * *}$ | $0.00535^{* * *}$ | $0.00906^{* * *}$ | $0.00474^{* * *}$ |
|  | $(0.000138)$ | $(0.000343)$ | $(0.000140)$ | $(0.000254)$ | $(0.000147)$ |
| Offering dummy | $-0.00375^{* * *}$ | $-0.00659^{* * *}$ | $-0.00312^{* * *}$ | $-0.00373^{* * *}$ | $-0.00333^{* * *}$ |
|  | $(0.000357)$ | $(0.00112)$ | $(0.000386)$ | $(0.000682)$ | $(0.000353)$ |
| Constant | $0.135^{* * *}$ | $0.124^{* * *}$ | $0.124^{* * *}$ | $0.126^{* * *}$ | $0.122^{* * *}$ |
| Observations | $(0.00347)$ | $(0.00918)$ | $(0.00337)$ | $(0.00599)$ | $(0.00352)$ |
| R-squared | $1,163,173$ | 180,338 | 982,835 | 403,930 | 759,243 |

Table 4.57: Average difference in Turnover measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bond with a AA pure rating
This table shows results from the ordinary least squares regression of the Turnover measure on an insured dummy
where Turnover $_{i}$ represents the Turnover measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer
downgrade from June 2008 to December 2009. downgrade from June 2008 to December 2009

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | $-0.000967^{* * *}$ |
| Insurance effect | $-0.00147^{* * *}$ | $-0.00490^{* * *}$ | $-0.00146^{* * *}$ | $-0.00442^{* * *}$ | $(0.000338)$ |
|  | $(0.000466)$ | $(0.00130)$ | $(0.000499)$ | $-0.000705^{* * *}$ |  |
| Log(maturity) | 0.000201 | $0.00422^{* * *}$ | -0.000131 | $(0.000147)$ |  |
|  | $(0.000209)$ | $(0.000418)$ | $(0.000221)$ | $(0.00080130)$ | $-0.0149^{* * *}$ |
| Size dummy | $-0.0173^{* * *}$ | $-0.0198^{* * *}$ | $-0.0163^{* * *}$ | $-0.0204^{* * *}$ | $(0.000191)$ |
| Time outstanding | $(0.000214)$ | $(0.000416)$ | $(0.000223)$ | $-0.000417)$ | $-0.00256^{* * *}$ |
|  | $-0.00271^{* * *}$ | $-0.00341^{* * *}$ | $-0.00263^{* * *}$ | $-0.00368^{* * *}$ | $(0.000136)$ |
| Log(issue size) | $(0.000194)$ | $(0.000774)$ | $(0.000205)$ | $-0.0104^{* * *}$ |  |
|  | $-0.0111^{* * *}$ | $-0.0143^{* * *}$ | $-0.0104^{* * *}$ | $-0.0121^{* * *}$ | $(0.000367)$ |
| Log(bond size) | $(0.000382)$ | $(0.00115)$ | $(0.000360)$ | $(0.000789)$ | $0.00537^{* * *}$ |
|  | $0.00634^{* * *}$ | $0.0104^{* * *}$ | $0.00572^{* * *}$ | $0.00837^{* * *}$ | $(0.000182)$ |
| Offering dummy | $(0.000198)$ | $(0.000555)$ | $(0.000196)$ | $(0.000498)$ | $-0.00453^{* * *}$ |
| Constant | $-0.00487^{* * *}$ | $-0.00623^{* *}$ | $-0.00464^{* * *}$ | $-0.00420^{*}$ | $(0.000682)$ |
|  | $(0.000843)$ | $(0.00283)$ | $(0.000925)$ | $0.00248)$ | $0.135^{* * *}$ |
| Observations | $0.141^{* * *}$ | $0.145^{* * *}$ | $0.130^{* * *}$ | $0.132^{* * *}$ | $(0.00544)$ |
| R-squared | $(0.00561)$ | $(0.0169)$ | $(0.00506)$ |  |  |

Table 4.58: Average difference in Turnover measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bond with a A pure rating
This table shows results from the ordinary least squares regression of the Turnover measure on an insured dummy
where Turnover $_{i}$ represents the Turnover measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insurance effect | $\begin{aligned} & -0.000792 \\ & (0.000646) \end{aligned}$ | $\begin{gathered} -0.00693^{* * *} \\ (0.00216) \end{gathered}$ | $\begin{aligned} & -0.000581 \\ & (0.000608) \end{aligned}$ | $\begin{gathered} -0.000894 \\ (0.00126) \end{gathered}$ | $\begin{gathered} -0.00105^{*} \\ (0.000619) \end{gathered}$ |
| Log(maturity) | $\begin{gathered} -0.000513 \\ (0.00109) \end{gathered}$ | $\begin{gathered} 0.00422^{* * *} \\ (0.000599) \end{gathered}$ | $\begin{aligned} & -0.00104 \\ & (0.00122) \end{aligned}$ | $\begin{gathered} 0.00318^{* * *} \\ (0.000372) \end{gathered}$ | $\begin{aligned} & -0.00204 \\ & (0.00153) \end{aligned}$ |
| Size dummy | $\begin{aligned} & -0.0181 * * * \\ & (0.000645) \end{aligned}$ | $\begin{aligned} & -0.0227^{* * *} \\ & (0.000572) \end{aligned}$ | $\begin{gathered} -0.0160^{* * *} \\ (0.000749) \end{gathered}$ | $\begin{aligned} & -0.0222^{* * *} \\ & (0.000474) \end{aligned}$ | $\begin{aligned} & -0.0137^{* * *} \\ & (0.000991) \end{aligned}$ |
| Time outstanding | $\begin{gathered} -0.00220^{* * *} \\ (0.000240) \end{gathered}$ | $\begin{gathered} -0.00299^{* *} \\ (0.00126) \end{gathered}$ | $\begin{gathered} -0.00228^{* * *} \\ (0.000227) \end{gathered}$ | $\begin{gathered} -0.00305^{* * *} \\ (0.000659) \end{gathered}$ | $\begin{gathered} -0.00205^{* * *} \\ (0.000223) \end{gathered}$ |
| $\log$ (issue size) | $\begin{aligned} & -0.0107^{* * *} \\ & (0.000535) \end{aligned}$ | $\begin{gathered} -0.0174^{* * *} \\ (0.00124) \end{gathered}$ | $\begin{gathered} -0.00939^{* * *} \\ (0.000555) \end{gathered}$ | $\begin{aligned} & -0.0147^{* * *} \\ & (0.000901) \end{aligned}$ | $\begin{gathered} -0.00846^{* * *} \\ (0.000629) \end{gathered}$ |
| Log(bond size) | $\begin{gathered} 0.00629^{* * *} \\ (0.000514) \end{gathered}$ | $\begin{aligned} & 0.0139 * * * \\ & (0.000818) \end{aligned}$ | $\begin{gathered} 0.00521^{* * *} \\ (0.000566) \end{gathered}$ | $\begin{aligned} & 0.0100^{* * *} \\ & (0.000512) \end{aligned}$ | $\begin{gathered} 0.00452^{* * *} \\ (0.000691) \end{gathered}$ |
| Offering dummy | $\begin{gathered} -0.00583^{* * *} \\ (0.000848) \end{gathered}$ | $\begin{gathered} -0.0126^{* * *} \\ (0.00250) \end{gathered}$ | $\begin{gathered} -0.00454^{* * *} \\ (0.000840) \end{gathered}$ | $\begin{gathered} -0.00820^{* * *} \\ (0.00169) \end{gathered}$ | $\begin{gathered} -0.00464^{* * *} \\ (0.000758) \end{gathered}$ |
| Constant | $\begin{aligned} & 0.139 * * * \\ & (0.00738) \end{aligned}$ | $\begin{gathered} 0.149^{* * *} \\ (0.0188) \end{gathered}$ | $\begin{aligned} & 0.123^{* * *} \\ & (0.00724) \end{aligned}$ | $\begin{gathered} 0.152^{* * *} \\ (0.0141) \end{gathered}$ | $\begin{aligned} & 0.111^{* * *} \\ & (0.00779) \end{aligned}$ |
| Observations | 251,348 | 39,309 | 212,039 | 92,217 | 159,131 |
| R-squared | 0.159 | 0.354 | 0.156 | 0.295 | 0.154 |

Table 4.59: Average difference in Turnover measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bond with a AAA actual rating
This table shows results from the ordinary least squares regression of the Turnover measure on an insured dummy
where Turnover $_{i}$ represents the Turnover measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insurance effect | $\begin{gathered} -0.00221^{* * *} \\ (0.000743) \end{gathered}$ | $\begin{gathered} -0.00861^{* * *} \\ (0.00213) \end{gathered}$ | $\begin{gathered} -0.00234^{* * *} \\ (0.000766) \end{gathered}$ | $\begin{gathered} -0.00578^{* * *} \\ (0.00181) \end{gathered}$ | $\begin{gathered} -0.00230^{* * *} \\ (0.000556) \end{gathered}$ |
| Log(maturity) | $\begin{gathered} 0.000977^{* * *} \\ (0.000142) \end{gathered}$ | $\begin{gathered} 0.00429^{* * *} \\ (0.000328) \end{gathered}$ | $\begin{gathered} 0.000628^{* * *} \\ (0.000146) \end{gathered}$ | $\begin{aligned} & 0.00309^{* * *} \\ & (0.000229) \end{aligned}$ | $\begin{gathered} -3.08 \mathrm{e}-05 \\ (0.000154) \end{gathered}$ |
| Size dummy | $\begin{aligned} & -0.0156^{* * *} \\ & (0.000191) \end{aligned}$ | $\begin{aligned} & -0.0167^{* * *} \\ & (0.000337) \end{aligned}$ | $\begin{aligned} & -0.0148^{* * *} \\ & (0.000201) \end{aligned}$ | $\begin{aligned} & -0.0177^{* * *} \\ & (0.000283) \end{aligned}$ | $\begin{aligned} & -0.0130^{* * *} \\ & (0.000206) \end{aligned}$ |
| Time outstanding | $\begin{gathered} -0.00213^{* * *} \\ (0.000111) \end{gathered}$ | $\begin{gathered} -0.00315^{* * *} \\ (0.000584) \end{gathered}$ | $\begin{gathered} -0.00217^{* * *} \\ (0.000110) \end{gathered}$ | $\begin{gathered} -0.00289^{* * *} \\ (0.000283) \end{gathered}$ | $\begin{gathered} -0.00208^{* * *} \\ (0.000104) \end{gathered}$ |
| Log(issue size) | $\begin{gathered} -0.00990^{* * *} \\ (0.000402) \end{gathered}$ | $\begin{gathered} -0.0123^{* * *} \\ (0.00118) \end{gathered}$ | $\begin{gathered} -0.00947^{* * *} \\ (0.000381) \end{gathered}$ | $\begin{aligned} & -0.0114^{* * *} \\ & (0.000752) \end{aligned}$ | $\begin{gathered} -0.00874^{* * *} \\ (0.000347) \end{gathered}$ |
| Log(bond size) | $\begin{gathered} 0.00538^{* * *} \\ (0.000169) \end{gathered}$ | $\begin{gathered} 0.00791^{* * *} \\ (0.000453) \end{gathered}$ | $\begin{gathered} 0.00492^{* * *} \\ (0.000160) \end{gathered}$ | $\begin{gathered} 0.00713^{* * *} \\ (0.000319) \end{gathered}$ | $\begin{gathered} 0.00419 * * * \\ (0.000148) \end{gathered}$ |
| Offering dummy | $\begin{gathered} -0.00238^{* * *} \\ (0.000410) \end{gathered}$ | $\begin{gathered} -0.00646^{* * *} \\ (0.00198) \end{gathered}$ | $\begin{gathered} -0.00167^{* * *} \\ (0.000406) \end{gathered}$ | $\begin{gathered} -0.00410^{* * *} \\ (0.00110) \end{gathered}$ | $\begin{gathered} -0.00180^{* * *} \\ (0.000371) \end{gathered}$ |
| Constant | $\begin{aligned} & 0.126^{* * *} \\ & (0.00643) \end{aligned}$ | $\begin{gathered} 0.130^{* * *} \\ (0.0189) \end{gathered}$ | $\begin{aligned} & 0.118 * * * \\ & (0.00616) \end{aligned}$ | $\begin{gathered} 0.125^{* * *} \\ (0.0116) \end{gathered}$ | $\begin{aligned} & 0.115^{* * *} \\ & (0.00580) \end{aligned}$ |
| Observations | 459,510 | 81,174 | 378,336 | 190,896 | 268,614 |
| R-squared | 0.221 | 0.296 | 0.225 | 0.258 | 0.242 |

Table 4.60: Average difference in Turnover measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bond with a AA actual rating
This table shows results from the ordinary least squares regression of the Turnover measure on an insured dummy
where Turnover $_{i}$ represents the Turnover measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insurance effect | $\begin{gathered} 0.000645 \\ (0.000535) \end{gathered}$ | $\begin{aligned} & -0.00125 \\ & (0.00189) \end{aligned}$ | $\begin{gathered} -8.13 \mathrm{e}-05 \\ (0.000557) \end{gathered}$ | $\begin{gathered} 0.00134 \\ (0.00166) \end{gathered}$ | $\begin{aligned} & -0.000774^{*} \\ & (0.000453) \end{aligned}$ |
| Log(maturity) | $\begin{aligned} & -0.000176 \\ & (0.000245) \end{aligned}$ | $\begin{gathered} 0.00479 * * * \\ (0.000560) \end{gathered}$ | $\begin{aligned} & -0.000433^{*} \\ & (0.000255) \end{aligned}$ | $\begin{gathered} 0.00412^{* * *} \\ (0.00127) \end{gathered}$ | $\begin{gathered} -0.000979^{* * *} \\ (0.000161) \end{gathered}$ |
| Size dummy | $\begin{aligned} & -0.0174^{* * *} \\ & (0.00239) \end{aligned}$ | $\begin{aligned} & -0.0204^{* * *} \\ & (0.00531) \end{aligned}$ | $\begin{aligned} & -0.0164^{* * *} \\ & (0.000251) \end{aligned}$ | $\begin{aligned} & -0.0213^{* * *} \\ & (0.000586) \end{aligned}$ | $\begin{aligned} & -0.0151^{* * *} \\ & (0.000206) \end{aligned}$ |
| Time outstanding | $\begin{gathered} -0.00319^{* * *} \\ (0.000215) \end{gathered}$ | $\begin{gathered} -0.00369^{* * *} \\ (0.00113) \end{gathered}$ | $\begin{gathered} -0.00296^{* * *} \\ (0.000218) \end{gathered}$ | $\begin{gathered} -0.00496^{* * *} \\ (0.00124) \end{gathered}$ | $\begin{gathered} -0.00271^{* * *} \\ (0.000156) \end{gathered}$ |
| $\log$ (issue size) | $\begin{aligned} & -0.0121^{* * *} \\ & (0.000397) \end{aligned}$ | $\begin{gathered} -0.0162^{* * *} \\ (0.00122) \end{gathered}$ | $\begin{aligned} & -0.0112^{* * *} \\ & (0.000384) \end{aligned}$ | $\begin{aligned} & -0.0148^{* * *} \\ & (0.000867) \end{aligned}$ | $\begin{aligned} & -0.0110^{* * *} \\ & (0.000414) \end{aligned}$ |
| Log(bond size) | $\begin{gathered} 0.00733^{* * *} \\ (0.000219) \end{gathered}$ | $\begin{aligned} & 0.0146^{* * *} \\ & (0.000744) \end{aligned}$ | $\begin{gathered} 0.00635^{* * *} \\ (0.000216) \end{gathered}$ | $\begin{aligned} & 0.0118^{* * *} \\ & (0.000730) \end{aligned}$ | $\begin{gathered} 0.00582^{* * *} \\ (0.000206) \end{gathered}$ |
| Offering dummy | $\begin{gathered} -0.00631^{* * *} \\ (0.00101) \end{gathered}$ | $\begin{gathered} -0.00639^{* *} \\ (0.00260) \end{gathered}$ | $\begin{gathered} -0.00620^{* * *} \\ (0.00114) \end{gathered}$ | $\begin{aligned} & -0.00419 \\ & (0.00287) \end{aligned}$ | $\begin{gathered} -0.00595^{* * *} \\ (0.000794) \end{gathered}$ |
| Constant | $\begin{aligned} & 0.142^{* * *} \\ & (0.00586) \end{aligned}$ | $\begin{gathered} 0.113^{* * *} \\ (0.0178) \end{gathered}$ | $\begin{aligned} & 0.139^{* * *} \\ & (0.00547) \end{aligned}$ | $\begin{gathered} 0.125^{* * *} \\ (0.0102) \end{gathered}$ | $\begin{aligned} & 0.142^{* * *} \\ & (0.00616) \end{aligned}$ |
| Observations | 373,125 | 36,613 | 336,512 | 82,587 | 290,538 |
| R-squared | 0.194 | 0.399 | 0.184 | 0.127 | 0.317 |

Table 4.61: Average difference in Turnover measure between insured and uninsured municipal bonds with issuer fixed effects, time fixed effects and controls for bond with a A actual rating
This table shows results from the ordinary least squares regression of the Turnover measure on an insured dummy
where Turnover $_{i}$ represents the Turnover measure for municipal bond i, Insured is one if bond i is insured and zero otherwise, $\gamma_{I s s u e r}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*},{ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insurance effect | $\begin{aligned} & 0.00244^{* * *} \\ & (0.000836) \end{aligned}$ | $\begin{gathered} 0.00209 \\ (0.00407) \end{gathered}$ | $\begin{gathered} 0.00211^{* * *} \\ (0.000755) \end{gathered}$ | $\begin{gathered} 0.00276 \\ (0.00200) \end{gathered}$ | $\begin{gathered} 0.00121 \\ (0.000809) \end{gathered}$ |
| Log(maturity) | $\begin{aligned} & -0.00109 \\ & (0.00171) \end{aligned}$ | $\begin{gathered} 0.00482^{* * *} \\ (0.000960) \end{gathered}$ | $\begin{aligned} & -0.00185 \\ & (0.00190) \end{aligned}$ | $\begin{gathered} 0.00452^{* * *} \\ (0.000567) \end{gathered}$ | $\begin{gathered} -0.00297 \\ (0.00224) \end{gathered}$ |
| Size dummy | $\begin{gathered} -0.0183^{* * *} \\ (0.00108) \end{gathered}$ | $\begin{aligned} & -0.0213^{* * *} \\ & (0.000804) \end{aligned}$ | $\begin{gathered} -0.0160^{* * *} \\ (0.00124) \end{gathered}$ | $\begin{aligned} & -0.0213^{* * *} \\ & (0.000604) \end{aligned}$ | $\begin{gathered} -0.0144^{* * *} \\ (0.00152) \end{gathered}$ |
| Time outstanding | $\begin{gathered} -0.00354^{* * *} \\ (0.000383) \end{gathered}$ | $\begin{gathered} -0.00987^{* * *} \\ (0.00277) \end{gathered}$ | $\begin{gathered} -0.00332^{* * *} \\ (0.000342) \end{gathered}$ | $\begin{gathered} -0.00795^{* * *} \\ (0.00145) \end{gathered}$ | $\begin{gathered} -0.00290^{* * *} \\ (0.000344) \end{gathered}$ |
| Log(issue size) | $\begin{aligned} & -0.0122^{* * *} \\ & (0.000765) \end{aligned}$ | $\begin{gathered} -0.0252^{* * *} \\ (0.00197) \end{gathered}$ | $\begin{aligned} & -0.0106^{* * *} \\ & (0.000806) \end{aligned}$ | $\begin{gathered} -0.0188^{* * *} \\ (0.00128) \end{gathered}$ | $\begin{gathered} -0.00982^{* * *} \\ (0.000914) \end{gathered}$ |
| Log(bond size) | $\begin{gathered} 0.00766^{* * *} \\ (0.000777) \end{gathered}$ | $\begin{gathered} 0.0231^{* * *} \\ (0.00137) \end{gathered}$ | $\begin{gathered} 0.00603^{* * *} \\ (0.000849) \end{gathered}$ | $\begin{aligned} & 0.0151^{* * *} \\ & (0.000841) \end{aligned}$ | $\begin{gathered} 0.00537^{* * *} \\ (0.000991) \end{gathered}$ |
| Offering dummy | $\begin{gathered} -0.00960^{* * *} \\ (0.00107) \end{gathered}$ | $\begin{gathered} -0.0198^{* * *} \\ (0.00407) \end{gathered}$ | $\begin{gathered} -0.00777^{* * *} \\ (0.00101) \end{gathered}$ | $\begin{gathered} -0.0131^{* * *} \\ (0.00211) \end{gathered}$ | $\begin{gathered} -0.00787^{* * *} \\ (0.00107) \end{gathered}$ |
| Constant | $\begin{gathered} 0.151^{* * *} \\ (0.0101) \end{gathered}$ | $\begin{gathered} 0.151^{* * *} \\ (0.0303) \end{gathered}$ | $\begin{gathered} 0.138^{* * *} \\ (0.0102) \end{gathered}$ | $\begin{gathered} 0.149^{* * *} \\ (0.0209) \end{gathered}$ | $\begin{gathered} 0.143^{* * *} \\ (0.0110) \end{gathered}$ |
| Observations | 143,006 | 19,212 | 123,794 | 41,405 | 101,601 |
| R-squared | 0.160 | 0.447 | 0.157 | 0.395 | 0.154 |

Table 4.62: Effect of change in insurance status on Turnover with time controls This table shows results from the difference in difference regression below:

$$
\begin{aligned}
\text { Turnover }_{i, j} & =\beta_{1} * \text { Insured }+\beta_{2} * \text { PreEvent } * \text { Insured }+\beta_{3} * \text { PreEvent }+\underline{\beta} * X_{i, j} \\
& +\beta * X_{i, j} * \text { PreEvent }+\beta_{s} * \gamma_{s} * \text { PreEvent }+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i, j}
\end{aligned}
$$

where Turnover $_{i, j}$ represents the turnover measure for municipal bond i , issued by issuer j . PreEvent is 1 if date of measure is before the give event, and $X_{i, j}$ is a vector of k standard controls, Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, and $\epsilon_{i}$ is an error term. Each specification, is a different event. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is run using the stock price drop of the insurers as the event. $\underline{\text { Specification } 2 \text { is run using the downgrade of the insurers as the event. }}$

|  | Stock Drop | Ratings Downgrade |
| :--- | :---: | :---: |
| insuredpartial | $-0.000760^{* *}$ | $-0.000568^{* *}$ |
|  | $(0.000380)$ | $(0.000275)$ |
| predowngrade |  | $0.00925^{* * *}$ |
|  |  | $(0.00113)$ |
| prestock | $0.0213^{* * *}$ |  |
| Insurance effect | $(0.00355)$ | $-0.00309^{* * *}$ |
|  | $-0.00335^{* * *}$ | $(0.000241)$ |
| Log(maturity) | $(0.000243)$ | -0.000183 |
|  | $-0.000670^{* *}$ | $(0.000275)$ |
| Size dummy | $(0.000293)$ | $-0.0198^{* * *}$ |
|  | $-0.0185^{* * *}$ | $(0.000215)$ |
| Time outstanding | $(0.000233)$ | $-0.00328^{* * *}$ |
|  | $-0.00314^{* * *}$ | $(0.000102)$ |
| Log(issue size) | $(0.000101)$ | $-0.0115^{* * *}$ |
|  | $-0.0107^{* * *}$ | $(0.000216)$ |
| Log(bond size) | $(0.000228)$ | $0.00630^{* * *}$ |
| Offering dummy | $0.00559^{* * *}$ | $(0.000138)$ |
| Constant | $(0.000140)$ | $-0.00397^{* * *}$ |
|  | $-0.00402^{* * *}$ | $(0.000247)$ |
| Observations | $(0.000249)$ | $0.140^{* * *}$ |
| R-squared | $0.138^{* * *}$ | $(0.00317)$ |

Table 4.63: Effect of change in insurance status on Turnover with time controls, issuer controls, underlying rating dummies and controls
This table shows results from the difference in difference regression below:

$$
\begin{aligned}
\text { Turnover }_{i, j} & =\beta_{1} * \text { Insured }+\beta_{2} * \text { PreEvent } * \text { Insured }+\beta_{3} * \text { PreEvent }+\underline{\beta} * X_{i, j} \\
& +\beta * X_{i, j} * \text { PreEvent }+\beta_{s} * \gamma_{s} * \text { PreEvent }+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i, j}
\end{aligned}
$$

where Turnover ${ }_{i, j}$ represents the turnover measure for municipal bond i , issued by issuer j . PreEvent is 1 if date of measure is before the give event, and $X_{i, j}$ is a vector of k standard controls, Insured is one if bond i is insured and zero otherwise, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, and $\epsilon_{i}$ is an error term. Each specification, is a different event. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is run using the stock price drop of the insurers as the event. Specification 2 is run using the downgrade of the insurers as the event.

|  | Stock Drop | Ratings Downgrade |
| :--- | :---: | :---: |
| insuredpartial | $-0.00138^{* * *}$ | -0.000107 |
|  | $(0.000490)$ | $(0.000402)$ |
| prestock | $0.0185^{* * *}$ |  |
| predowngrade | $(0.00333)$ | $0.0237^{* * *}$ |
|  |  | $(0.00249)$ |
| Insurance effect | $-0.00152^{* * *}$ | $-0.00179^{* * *}$ |
|  | $(0.000319)$ | $(0.000284)$ |
| Log(maturity) | -0.000241 | $-0.000874^{* * *}$ |
|  | $(0.000267)$ | $(0.000286)$ |
| Size dummy | $-0.0163^{* * *}$ | $-0.0146^{* * *}$ |
|  | $(0.000215)$ | $(0.000237)$ |
| Time outstanding | $-0.00252^{* * *}$ | $-0.00220^{* * *}$ |
|  | $(0.000107)$ | $(9.04 \mathrm{e}-05)$ |
| Log(issue size) | $-0.0102^{* * *}$ | $-0.00952^{* * *}$ |
|  | $(0.000247)$ | $(0.000246)$ |
| Log(bond size) | $0.00553^{* * *}$ | $0.00495^{* * *}$ |
| Offering dummy | $(0.000154)$ | $(0.000157)$ |
|  | $-0.00447^{* * *}$ | $-0.00464^{* * *}$ |
| Constant | $(0.000425)$ | $(0.000425)$ |
|  | $0.131^{* * *}$ | $0.128^{* * *}$ |
| Observations | $(0.00362)$ | $(0.00366)$ |
| R-squared |  | 995,482 |
|  | 995,482 | 0.173 |

Table 4.64: Average difference in Turnover measure between AAA-rated and non AAA-rated municipal bonds with issuer fixed effects, time fixed effects and controls
This table shows results from the ordinary least squares regression of the Turnover measure on a AAA dummy

$$
\text { Turnover }_{i}=\beta_{1} * A A A+\underline{\beta} * X_{i, k}+\beta_{\text {Issuer }} * \gamma_{\text {Issuer }}+\beta_{s} * \gamma_{s}+\beta_{t} * \gamma_{t}+\epsilon_{i}
$$

where Turnover ${ }_{i}$ represents the Turnover measure for municipal bond i, AAA is one if bond i has an actual rating of AAA and zero otherwise, $\gamma_{\text {Issuer }}$ is a fixed effect controlling for issuer specific effects, $\gamma_{s}$ is a set of state controls, $\gamma_{t}$ is a set of time controls, $X_{i, k}$ is a vector of k standard municipal bond controls, and $\epsilon_{i}$ is an error term. Each specification, is a different time period. Standard errors clustered by cusip are shown in parentheses. ${ }^{*}$, ${ }^{* *}$, and ${ }^{* * *}$ denote significance at the $10 \%, 5 \%$, and $1 \%$ level, respectively. Specification 1 is the full sample from January 2006 to December 2009. Specification 2 covers the time period before the insurers stock price fell from January 2006 to June 2007. Specification 3 is after the insurers stock price fell to the end of the time period from July 2007 to December 2009. Specification 4 is the time period until the insurers were downgraded from January 2006 to May 2008. Specification 5 covers the time period after the insurer downgrade from June 2008 to December 2009.

|  | Full Sample | Pre Stock Drop | Post Stock Drop | Pre Downgrade | Post Downgrade |
| :---: | :---: | :---: | :---: | :---: | :---: |
| AAA effect | $-0.00545^{* * *}$ | $-0.0132^{* * *}$ | $-0.00392^{* * *}$ | $-0.0104^{* * *}$ | $-0.00235^{* * *}$ |
|  | (0.000171) | (0.000413) | (0.000191) | (0.000331) | (0.000213) |
| Log(maturity) | 0.000227 | $0.00528^{* * *}$ | -0.000219 | $0.00377^{* * *}$ | $-0.000928^{* * *}$ |
|  | (0.000252) | (0.000292) | (0.000275) | (0.000375) | (0.000307) |
| Size dummy | $-0.0174^{* * *}$ | $-0.0196^{* * *}$ | $-0.0162^{* * *}$ | $-0.0205^{* * *}$ | $-0.0145^{* * *}$ |
|  | (0.000196) | (0.000283) | (0.000215) | (0.000254) | (0.000239) |
| Time outstanding | $-0.00265^{* * *}$ | $-0.00363^{* * *}$ | $-0.00262^{* * *}$ | $-0.00354^{* * *}$ | -0.00255*** |
|  | (9.10e-05) | (0.000521) | (9.21e-05) | (0.000376) | (7.57e-05) |
| Log(issue size) | $-0.0110^{* * *}$ | -0.0155*** | $-0.0102^{* * *}$ | $-0.0133^{* * *}$ | -0.00977*** |
|  | (0.000251) | (0.000736) | (0.000242) | (0.000485) | (0.000248) |
| Log(bond size) | $0.00645^{* * *}$ | $0.0119{ }^{* * *}$ | $0.00562^{* * *}$ | $0.00940^{* * *}$ | $0.00506^{* * *}$ |
|  | (0.000153) | (0.000392) | (0.000156) | (0.000296) | (0.000162) |
| Offering dummy | $-0.00455^{* * *}$ | -0.00825*** | -0.00387*** | -0.00589*** | -0.00384*** |
|  | (0.000424) | (0.00140) | (0.000457) | (0.000966) | (0.000383) |
| Constant | $0.139^{* * *}$ | $0.137^{* * *}$ | $0.129^{* * *}$ | $0.134^{* * *}$ | $0.131^{* * *}$ |
|  | (0.00374) | (0.0109) | (0.00354) | (0.00682) | (0.00372) |
| Observations | 995,482 | 140,914 | 854,568 | 322,943 | 672,539 |
| R-squared | 0.172 | 0.360 | 0.167 | 0.194 | 0.175 |


4.10: A positive Amihud measure represents a decrease in liquidity. The vertical line represent the date of the 'stock price drop. Dashed lines represent the $95 \%$ confidence interval.

4.11: A positive Bid-Ask measure represents a decrease in liquidity. The vertical line represent the date of the 'stock price drop. Dashed lines represent the $95 \%$ confidence interval.

4.12: A positive Turnover measure represents an increase in liquidity. The vertical line represent the date of the 'stock price drop. Dashed lines represent the $95 \%$ confidence interval.

4.13: A positive Amihud measure represents a decrease in liquidity. Graph includes underlying rating controls. tical line represent the date of the insurers' stock price drop. Dashed lines represent the 95\% confidence interval.

4.14: A positive Bid-Ask measure represents a decrease in liquidity. Graph includes underlying rating controls.
tical line represent the date of the insurers's stock price drop. Dashed lines represent the $95 \%$ confidence interval. $\quad \pm$

4.15: A positive Turnover measure represents an increase in liquidity. Graph includes underlying rating controls. tical line represent the date of the insurers' stock price drop. Dashed lines represent the $95 \%$ confidence interval.

### 4.3 Third chapter

Table 4.65: Descriptive Statistics of data in each index

| Index | Count | Coupon (in Percent) | Maturity (in Years) | Bond Size (in \$) |
| :---: | :---: | :---: | :---: | :---: |
| Market Wide | 373,213 | 4.33 | 10.4 | 4,865,753.5 |
|  |  | (1.18) | (6.13) | (23,531,130.2) |
| AAA | 241,395 | 4.30 | 10.6 | 4,605,767.2 |
|  |  | (1.22) | (6.16) | $(14,817,059.6)$ |
| AA | 168,533 | 4.37 | 9.83 | 5,644,425.9 |
|  |  | (1.13) | (6.16) | (28,340,770.7) |
| A | 82,798 | 4.31 | 10.50 | 5,659590.6 |
|  |  | (1.27) | (6.62) | (26,378,606.0) |
| $\mathrm{BBB}+$ | 5,820 | 4.59 | 11.76 | 4,427,163.4 |
|  |  | (1.12) | (7.25) | $(16,272697.7)$ |
| GO | 155,976 | 4.17 | 9.99 | 3,605,415.3 |
|  |  | (1.30) | (5.67) | $(26,298,817.8)$ |
| NonGo | 217,237 | 4.45 | 10.75 | 5,772,176.0 |
|  |  | (1.08) | (6.52) | (21,273,615.0) |
| Insured | 238,996 | 4.30 | 10.52 | 3,874,722.3 |
|  |  | (1.21) | (6.12) | (13,524,795.4) |
| Uninsured | 134,217 | 4.38 | 10.27 | 6,613,926.3 |
|  |  | (1.12) | (6.32) | (34,684435.3) |
| California | 63,931 | 4.05 | 11.48 | 5,246,637.3 |
|  |  | (1.61) | (6.69) | (27,433,916.3) |
| New York | 27,132 | 4.52 | 10.43 | 9,613,983.5 |
|  |  | (.93) | (6.20) | (26,772,723.0) |
| 5 Year Maturity | 184,202 | 4.19 | 5.34 | 3,022,108.0 |
|  |  | (1.16) | (1.54) | (13,942,063.2) |
| 10 Year Maturity | 157,549 | 4.44 | 11.16 | 4,105,302.5 |
|  |  | (1.10) | (2.11) | (12,202,375.8) |
| 20 Year Maturity | 74,446 | 4.50 | 18.56 | 8,556,257.5 |
|  |  | (1.27) | (2.86) | (37,911,965.7) |
| 30 Year Maturity | 12,555 | 4.63 | 28.28 | 31,591,550.9 |
|  |  | (1.49) | (3.11) | $(98,816,137.7)$ |

Table 4.66: State Composition by each index (in percent of total bonds)

| Index | California | New York | Texas | Other |
| :--- | :---: | :---: | :---: | :---: |
| Market Wide | 17.1 | 7.3 | 13.5 | 62.1 |
| AAA | 19.0 | 7.1 | 14.6 | 59.3 |
| AA | 15.6 | 7.7 | 9.6 | 67.1 |
| A | 28.8 | 8.1 | 8.3 | 54.8 |
| BBB+ | 25.7 | 9.4 | 18.6 | 46.3 |
| GO | 18.2 | 6.5 | 15.4 | 59.9 |
| NonGo | 16.3 | 7.8 | 12.2 | 63.7 |
| Insured | 22.6 | 6.8 | 11.6 | 59 |
| Uninsured | 7.4 | 8.0 | 17.0 | 67.6 |
| California | 100 | 0 | 0 | 0 |
| New York | 0 | 100 | 0 | 0 |
| 5 Year Maturity | 15.3 | 7.6 | 11.7 | 65.4 |
| 10 Year Maturity | 17.7 | 7.4 | 13.6 | 61.3 |
| 20 Year Maturity | 21 | 7.1 | 16 | 55.9 |
| 30 Year Maturity | 24.6 | 7.9 | 13.2 | 54.3 |

Table 4.67: Composition for each index by revenue source

| Index | General Obligation | Non General Obligation |
| :--- | :---: | :---: |
| Market Wide | 41.8 | 58.2 |
| AAA | 39.6 | 60.4 |
| AA | 43.3 | 56.7 |
| A | 35.7 | 64.3 |
| BBB+ | 32.9 | 67.1 |
| GO | 100 | 0 |
| NonGo | 0 | 100 |
| Insured | 42.1 | 57.9 |
| Uninsured | 41.2 | 58.8 |
| California | 44.5 | 55.5 |
| New York | 37.4 | 62.6 |
| 5 Year Maturity | 42.3 | 57.7 |
| 10 Year Maturity | 42.3 | 57.7 |
| 20 Year Maturity | 39.7 | 60.3 |
| 30 Year Maturity | 21.3 | 78.7 |

Table 4.68: Composition of each index by rating (in percent)

| Index | AAA | AA | A | BBB + |
| :--- | :---: | :---: | :---: | :---: |
| Market Wide | 53 | 28.9 | 15.3 | 1.1 |
| AAA | 100 | 0 | 0 | 0 |
| AA | 0 | 100 | 0 | 0 |
| A | 0 | 0 | 100 | 0 |
| BBB+ | 0 | 0 | 0 | 100 |
| GO | 49.1 | 32.8 | 15.4 | 1 |
| NonGo | 55.8 | 26.1 | 15.2 | 1.2 |
| Insured | 62.8 | 17.6 | 17 | 1.1 |
| Uninsured | 35.7 | 49 | 12.2 | 1.1 |
| California | 56.2 | 16.3 | 23.7 | 1.8 |
| New York | 52.1 | 27.2 | 17.8 | 1.6 |
| 5 Year Maturity | 53.8 | 30.6 | 13.1 | .9 |
| 10 Year Maturity | 54.3 | 28.7 | 14.4 | 1 |
| 20 Year Maturity | 51.1 | 27.5 | 17.8 | 1.36 |
| 30 Year Maturity | 44.8 | 27.3 | 21.8 | 2.1 |

Table 4.69: Descriptive Statistics of each index

| Index | Standard Deviation | Min | Max |
| :--- | :---: | :---: | :---: |
| Market Wide | 33.4 | 36.7 | 197.5 |
| AAA | 35.1 | 29.4 | 179.8 |
| AA | 34.5 | 29.4 | 166 |
| A | 50.5 | 70 | 333.3 |
| BBB+ | 116.1 | 82.3 | 629.3 |
| GO | 34.4 | 28.8 | 170.3 |
| NonGo | 34.3 | 41.9 | 214.7 |
| Insured | 34.7 | 43.7 | 222.0 |
| Uninsured | 34.9 | 25.5 | 154.1 |
| California | 38.5 | 58.3 | 270.1 |
| New York | 36.5 | 27 | 193.1 |
| 5 Year Maturity | 41.2 | 17.7 | 152.9 |
| 10 Year Maturity | 35.3 | 42.2 | 229.9 |
| 20 Year Maturity | 58.6 | 74.2 | 372.3 |
| 30 Year Maturity | 69.4 | 75.3 | 439.4 |



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Time

Table 4.70: Correlation tables with repeat sales indices

|  | Market Wide | AAA | AA | A | BBB + | GO | NONGO | Insured |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Market Wide | 1 | 0.97 | 0.96 | 0.73 | 0.26 | 0.96 | 0.98 | 0.97 |
| AAA | 0.97 | 1 | 0.99 | 0.56 | 0.02 | 1 | 0.91 | 0.89 |
| AA | 0.96 | 0.99 | 1 | 0.54 | 0.03 | 1 | 0.9 | 0.88 |
| A | 0.73 | 0.56 | 0.54 | 1 | 0.79 | 0.51 | 0.84 | 0.85 |
| BBB+ | 0.26 | 0.02 | 0.03 | 0.79 | 1 | -0.02 | 0.43 | 0.46 |
| GO | 0.96 | 1 | 1 | 0.51 | -0.02 | 1 | 0.89 | 0.87 |
| NONGO | 0.98 | 0.91 | 0.9 | 0.84 | 0.43 | 0.89 | 1 | 1 |
| Insured | 0.97 | 0.89 | 0.88 | 0.85 | 0.46 | 0.87 | 1 | 1 |
| Uninsured | 0.93 | 0.99 | 0.99 | 0.45 | -0.08 | 1 | 0.85 | 0.83 |
| California | 0.79 | 0.61 | 0.62 | 0.95 | 0.77 | 0.59 | 0.88 | 0.9 |
| New York | 0.99 | 0.99 | 0.99 | 0.63 | 0.14 | 0.99 | 0.95 | 0.93 |
| 5 Year Maturity | 0.83 | 0.92 | 0.94 | 0.24 | -0.26 | 0.95 | 0.71 | 0.68 |
| 10 Year Maturity | 0.98 | 0.91 | 0.9 | 0.83 | 0.39 | 0.89 | 0.99 | 1 |
| 20 Year Maturity | 0.58 | 0.37 | 0.36 | 0.95 | 0.9 | 0.33 | 0.73 | 0.75 |
| 30 Year Maturity | 0.42 | 0.19 | 0.19 | 0.89 | 0.96 | 0.15 | 0.58 | 0.61 |


|  | Uninsured | CA | NY | 5 Year | 10 Year | Twenty Year | Thirty Year |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Market Wide | 0.93 | 0.79 | 0.99 | 0.83 | 0.98 | 0.58 | 0.42 |
| AAA | 0.99 | 0.61 | 0.99 | 0.92 | 0.91 | 0.37 | 0.19 |
| AA | 0.99 | 0.62 | 0.99 | 0.94 | 0.9 | 0.36 | 0.19 |
| A | 0.45 | 0.95 | 0.63 | 0.24 | 0.83 | 0.95 | 0.89 |
| BBB+ | -0.08 | 0.77 | 0.14 | -0.26 | 0.39 | 0.9 | 0.96 |
| GO | 1 | 0.59 | 0.99 | 0.95 | 0.89 | 0.33 | 0.15 |
| NONGO | 0.85 | 0.88 | 0.95 | 0.71 | 0.99 | 0.73 | 0.58 |
| Insured | 0.83 | 0.9 | 0.93 | 0.68 | 1 | 0.75 | 0.61 |
| Uninsured | 1 | 0.53 | 0.97 | 0.97 | 0.85 | 0.26 | 0.08 |
| California | 0.53 | 1 | 0.7 | 0.34 | 0.87 | 0.93 | 0.87 |
| New York | 0.97 | 0.7 | 1 | 0.89 | 0.94 | 0.47 | 0.29 |
| 5 Year Maturity | 0.97 | 0.34 | 0.89 | 1 | 0.71 | 0.04 | -0.14 |
| 10 Year Maturity | 0.85 | 0.87 | 0.94 | 0.71 | 1 | 0.71 | 0.56 |
| 20 Year Maturity | 0.26 | 0.93 | 0.47 | 0.04 | 0.71 | 1 | 0.98 |
| 30 Year Maturity | 0.08 | 0.87 | 0.29 | -0.14 | 0.56 | 0.98 | 1 |

Table 4.71: Correlation tables with $\mathbf{S} \& \mathbf{P}$

|  | S\&P Market | S\&P GO | S\&P Revenue | S\&P CA | S\&P NY |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Market Wide | -0.8 | -0.74 | -0.68 | -0.78 | -0.8 |
| AAA | -0.81 | -0.83 | -0.56 | -0.77 | -0.84 |
| AA | -0.82 | -0.83 | -0.56 | -0.77 | -0.84 |
| A | -0.44 | -0.18 | -0.71 | -0.48 | -0.36 |
| BBB+ | -0.09 | 0.25 | -0.6 | -0.18 | 0.02 |
| GO | -0.82 | -0.85 | -0.54 | -0.77 | -0.85 |
| NONGO | -0.76 | -0.63 | -0.74 | -0.75 | -0.73 |
| Insured | -0.74 | -0.6 | -0.75 | -0.74 | -0.71 |
| Uninsured | -0.82 | -0.87 | -0.51 | -0.77 | -0.85 |
| California | -0.52 | -0.27 | -0.76 | -0.57 | -0.44 |
| New York | -0.82 | -0.8 | -0.63 | -0.79 | -0.83 |
| 5 Year Maturity | -0.76 | -0.88 | -0.35 | -0.69 | -0.82 |
| 10 Year Maturity | -0.74 | -0.63 | -0.72 | -0.74 | -0.71 |
| 20 Year Maturity | -0.33 | -0.02 | -0.71 | -0.39 | -0.22 |
| 30 Year Maturity | -0.2 | 0.13 | -0.65 | -0.27 | -0.08 |


|  | S\&P Inv. Grade | S\&P Junk | S\&P Insured | S\&P ST | S\&P LT |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Market Wide | -0.8 | 0.04 | -0.81 | -0.6 | -0.75 |
| AAA | -0.84 | 0.27 | -0.82 | -0.74 | -0.84 |
| AA | -0.84 | 0.26 | -0.82 | -0.76 | -0.84 |
| A | -0.37 | -0.53 | -0.44 | 0.06 | -0.19 |
| BBB+ | 0.01 | -0.89 | -0.08 | 0.47 | 0.24 |
| GO | -0.85 | 0.3 | -0.82 | -0.78 | -0.86 |
| NONGO | -0.74 | -0.13 | -0.76 | -0.46 | -0.64 |
| Insured | -0.72 | -0.16 | -0.75 | -0.42 | -0.61 |
| Uninsured | -0.85 | 0.36 | -0.82 | -0.82 | -0.88 |
| California | -0.46 | -0.53 | -0.52 | -0.06 | -0.28 |
| New York | -0.83 | 0.16 | -0.82 | -0.7 | -0.81 |
| 5 Year Maturity | -0.81 | 0.52 | -0.76 | -0.89 | -0.89 |
| 10 Year Maturity | -0.72 | -0.1 | -0.75 | -0.45 | -0.64 |
| 20 Year Maturity | -0.25 | -0.71 | -0.33 | 0.23 | -0.03 |
| 30 Year Maturity | -0.1 | -0.82 | -0.2 | 0.37 | 0.13 |

Table 4.72: Correlation tables with Bond Buyer
Bond Buyer 20 GO Bond Buyer 11 GO Bond Buyer 25 Revenue

| Market Wide | 0.32 | 0.49 | 0.08 |
| :--- | :---: | :---: | :---: |
| AAA | 0.15 | 0.35 | -0.13 |
| AA | 0.1 | 0.3 | -0.15 |
| A | 0.74 | 0.76 | 0.59 |
| BBB+ | 0.75 | 0.63 | 0.82 |
| GO | 0.1 | -0.17 |  |
| NONGO | 0.46 | 0.58 | 0.24 |
| Insured | 0.48 | 0.6 | 0.27 |
| Uninsured | 0.03 | 0.24 | -0.24 |
| California | 0.66 | 0.68 | 0.58 |
| New York | 0.21 | 0.39 | -0.05 |
| 5 Year Maturity | -0.18 | 0.04 | -0.43 |
| 10 Year Maturity | 0.45 | 0.58 | 0.23 |
| 20 Year Maturity | 0.8 | 0.77 | 0.75 |
| 30 Year Maturity | 0.8 | 0.72 | 0.82 |

Table 4.73: Correlation tables with Moody's

|  | AAA 20 | AAA 10 | AA 20 | AA 10 | Competitive. 20 | A 20 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Market Wide | 0.37 | 0.83 | 0.33 | 0.84 | 0.04 | 0.1 |
| AAA | 0.22 | 0.89 | 0.16 | 0.88 | -0.17 | -0.11 |
| AA | 0.17 | 0.85 | 0.11 | 0.84 | -0.2 | -0.13 |
| A | 0.71 | 0.46 | 0.69 | 0.49 | 0.6 | 0.62 |
| BBB+ | 0.66 | -0.07 | 0.7 | -0.02 | 0.82 | 0.84 |
| GO | 0.18 | 0.88 | 0.12 | 0.87 | -0.21 | -0.15 |
| NONGO | 0.48 | 0.77 | 0.45 | 0.78 | 0.2 | 0.26 |
| Insured | 0.5 | 0.75 | 0.47 | 0.77 | 0.24 | 0.3 |
| Uninsured | 0.11 | 0.86 | 0.05 | 0.85 | -0.28 | -0.22 |
| California | 0.64 | 0.47 | 0.65 | 0.5 | 0.56 | 0.6 |
| New York | 0.27 | 0.85 | 0.22 | 0.85 | -0.09 | -0.03 |
| 5 Year Maturity | -0.09 | 0.81 | -0.15 | 0.78 | -0.47 | -0.41 |
| 10 Year Maturity | 0.48 | 0.78 | 0.44 | 0.8 | 0.2 | 0.25 |
| 20 Year Maturity | 0.75 | 0.28 | 0.77 | 0.32 | 0.75 | 0.77 |
| 30 Year Maturity | 0.73 | 0.09 | 0.76 | 0.14 | 0.82 | 0.83 |


[^0]:    ${ }^{1}$ Tennant, Emery, and Van Praagh (2010), Gabriel Petek and Watson (2011)

[^1]:    ${ }^{2}$ Some municipalities choose not to get rated at all in which case the municipal bonds are unrated.
    ${ }^{3}$ The authors that use tic assume the cost of insurance is passed through to the underwriters. Therefore the insurance premium will be reflected in higher yields. Both tic studies include callable bonds in their samples.

[^2]:    ${ }^{1}$ General obligation bonds provide for the full faith and credit of the issuing municipality.

[^3]:    ${ }^{2}$ I recently learned of a new paper Corwin and Schultz (2011) that improves on Roll's Bid-Ask measure, which I intend to consider in further research.

[^4]:    Observations
    R-squared

[^5]:    AAA effect

