Credit Ratings and the Cost of Municipal Financing*

Jess Cornaggia
McDonough School of Business
Rafik Hariri Building
Georgetown University
37th and O St. NW
Washington, DC 20007
(202) 687-0100
jc2394@georgetown.edu

Kimberly J. Cornaggia
Kogod School of Business
American University
4400 Massachusetts Avenue NW
Washington, DC 20016
(202) 855-3908
kcornagg@american.edu

Ryan Israelsen
Kelley School of Business
Indiana University
1309 E. 10th Street
Bloomington, IN 47405
(812) 855-8435
risraels@indiana.edu

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Abstract

Moody's recalibrated its municipal bond rating scale in 2010, resulting in upgrades of zero to four notches on $2.2 trillion of bonds. We find the upgraded bonds earn abnormal returns, increasing in upgrade magnitude. Upgraded municipalities subsequently issue more bonds, relative to non-upgraded municipalities, and the new issues have lower relative offer yields. Additional tests indicate that ratings affect bond prices and debt capacity both because ratings provide information and because higher ratings reduce regulatory compliance costs. Overall, this recalibration event sheds light on the information environment in the municipal bond market and on the real effects of ratings.

I. Introduction

Municipal bond markets are large and the cost of municipal financing has real economic effects. However, the finance literature contains relatively few empirical studies examining these markets, likely due to the historical dearth of available data. Because this market is opaque relative to the more commonly studied corporate bond market, we posit that credit rating agencies (CRAs) are an especially important information intermediary in this market. Indeed, the underlying premise of recent lawsuits is that investors rely on credit ratings to price municipal bonds (munis).[1] The primary purpose of this paper is to test this underlying premise. The second purpose of this paper is to shed light on the channels through which ratings affect prices. We also provide an estimate of the costs to taxpayers of Moody's dual-class rating system.[2]

Testing the extent to which ratings impact markets is challenging. A host of papers finds contemporaneous changes in securities prices around ratings changes. However, because ratings changes are correlated with changes in observable fundamentals, it is difficult to ascertain whether ratings contain unique information or simply respond to the same information that markets price. We exploit Moody's recalibration of its municipal bond ratings scale to avoid this potential endogeneity problem.

In April and May of 2010, Moody's recalibrated muni bond ratings to align them with the ratings standards applied to other asset classes. Because these ratings changes were uncorrelated with changes in issuer fundamentals, this unique event provides a clean test of ratings' price impact. Importantly, not all municipal issues were upgraded. Municipal issuers that were already "well-calibrated" to the global scale for other asset classes serve as our control group. Because credit ratings on insured bonds reflect the credit quality of the insurer, we include only uninsured bonds in our analyses (roughly 60% of the $2.2 trillion recalibrated bonds are uninsured). Our

[1] In July 2008, the Attorney General of the State of Connecticut charged that dual-class ratings (i.e., rating munis on a more stringent scale than other asset classes) resulted in higher interest costs imposed on taxpayers.

[2] We make no argument regarding culpability. Moody's stated objective is to rank order securities (municipalities according to their expected need for assistance from higher levels of government; other securities according to expected losses). Further, Moody's has long publicized its dual-class rating system along with periodic comparisons of default rates for municipal bonds and like-rated securities in other asset classes.

primary sample consists of roughly equally-sized treatment and control groups: $642 billion of uninsured munis experienced upgrades due to recalibration, and $606 billion did not.

We find that the market re-priced the recalibrated munis. We use secondary market data from the Municipal Securities Rulemaking Board (MSRB) and compute cumulative abnormal returns (CARs) around the recalibration events. Post-recalibration CARs are nearly 40 basis points for munis upgraded one notch, relative to the control group. This effect increases in the magnitude of the recalibration. Bonds upgraded two (three) notches due to recalibration experience CARs of 80 (140) basis points. We consider next whether the observed price impact reflects an information effect, an increased demand from investors facing ratings-based regulatory and contractual constraints, or both.

In order to distinguish between these explanations, we categorize upgrades based on their likely regulatory implications. Specifically, reserve requirements and other ratings-based regulations are typically written around broad rating categories, not individual notches within broad rating categories (see Section IV.A for details). We restrict our treatment group to one-notch upgrades and separate bonds upgraded into a new broad rating category (e.g., from A1 to Aa3) from those that remain in the original broad rating category (e.g., A2 to A1). We observe marginally higher average CARs for the recalibrated bonds that cross a regulatory threshold. However, we also observe significantly positive CARs among those that do not cross a regulatory threshold, suggesting the re-pricing is at least in part an information effect.

We further test the ratings-based regulation channel by comparing the trading volume for recalibrated bonds. Consistent with an increased demand for securities with lower costs of regulatory compliance, we observe a significantly greater increase in trading volume for upgraded bonds that cross into a new broad rating category, relative to those that upgrade within the same broad category. The effect is stronger for customer trades (many customers face regulatory restrictions) than inter-dealer trades, further suggesting this trading reflects regulatory demand. Overall, the secondary market data support both explanations for the price impact of these ratings changes.

Next, we test for real economic effects of the recalibrated ratings. Specifically, we test whether the recalibration lowered the cost of future municipal financing and expanded the debt capacity of the affected municipalities. Because yields and spreads are time-varying, and because 2010 followed a recessionary period, we employ a multivariate difference-in-differences approach.[3] We find that after recalibration, yield spreads on new debt issues for the treatment group decline by 16 basis points relative to the control group. This result is robust to controlling for bond characteristics (par, maturity, coupon, liquidity), issuers' rating levels before or after recalibration, and issuance geography or issuer fixed effects. We also control for whether the bonds are General Obligation (GO) or revenue bonds, and whether the bonds are Build America Bonds (BAB). Like our results from the secondary market, the effect is larger in magnitude for municipalities whose bonds experienced larger upgrades. For each notch a municipality's outstanding bonds are upgraded, the offer yields on its new issues are 13 basis points lower than those of the control group.

These magnitudes are economically meaningful. Over $642 billion in uninsured municipal debt was upgraded during the recalibration. The product of $642 billion and 16 basis points, our baseline estimate of the effect of recalibration on yield spreads, is $1.03 billion dollars. This amount provides an estimate of aggregate excess interest paid annually (in 2010 dollars) by U.S. taxpayers associated with the dual-class rating system. For context, the average cost to build a new elementary school is approximately $7 million (in 2013 dollars).[4]

Having established pricing effects of credit ratings, we consider again the channel by which ratings affect municipal financing. Similar to the results from the secondary market data, we find evidence from new issues that ratings affect regulatory demand as well as provide

[3] We examine offer yields as well as before- and after-tax yield spreads because both the benchmark and premiums are time-varying (http://research.stlouisfed.org/fred2/series/BAMLC2A0C35Y). Our inferences are similar for all of our measures of spreads and yields.

[4] Source: Reed Construction Data (http://www.reedconstructiondata.com/rsmeans/models/high-school/)

information. Multivariate difference-in-differences results from the subsample of upgrades that should not have regulatory implications are statistically significant, indicating an information effect. However, the results are 70% larger in economic magnitude for upgrades that cross broad rating category thresholds.

We further test the information channel by comparing the impact of Moody's ratings across different information environments. We begin by splitting the treatment sample by issuer level of government. If ratings provide information, then we should observe a larger price impact among the smallest, most opaque issuers. Consistent with this notion, we find the difference-in-differences estimate from our multivariate approach is higher among cities (27 basis points) than counties (16 basis points) or states (5 basis points). We split the treatment sample by alternative proxies for issuer opacity, including corruption risk, a measure of transparency, and whether the issuer's bonds are also rated by Standard and Poor's (S&P). We find larger economic magnitudes for the more opaque subsample for each split. However, the price impact remains significant even among the relatively low-opacity subsamples. Overall, these results suggest that Moody's ratings are especially important among opaque issuers, indicating an information effect in addition to any regulation-driven effects.

Next, we test whether the affected municipalities capitalized on their lower borrowing costs. We observe that muni issuance reaches its in-sample peak six months following the recalibration, but only for the affected issuers. This finding provides corroborating evidence that ratings have real economic effects. We address potential selection bias by requiring municipalities to issue at least one bond in the year before and the year after recalibration for admission to our multivariate regressions. We also find that our results are not driven by municipalities that began in any particular rating category prior to recalibration or end up in any particular rating category afterward.

As a final exercise, we examine S&P's ratings around Moody's recalibration. Although S&P did not announce any formal recalibration of its municipal bond rating scale, it did revise many municipal ratings into AA+. This migration differs from Moody's recalibration in two important ways. First, unlike the zero-to-four notch range observed in Moody's recalibration, S&P's ratings migrated up as many as eight notches (from BBB- to AA+). Second, S&P also downgraded many bonds across the rating spectrum.

Our contributions to the literature include an analysis of the information environment in the $3.7 trillion municipal bond market, a clean test of the price impact of credit ratings free from confounding changes in issuer fundamentals, an analysis of the channels through which ratings affect prices (information or regulation-based demand), a thorough analysis of Moody's 2010 recalibration and the corresponding expansion in municipalities' debt capacity, and an estimate of the costs associated with incomparable rating scales.[5] This estimate is relevant as the SEC (2011) considers the Dodd-Frank mandate to standardize credit ratings across all rated securities (see §938).

II. Institutional Background and Literature Review

A. Moody's Dual Class Ratings

Unlike Moody's Global Scale ratings, which are designed to measure expected losses among corporate bonds, sovereign debt, and structured finance products, Moody's Municipal Rating Scale historically measured the how likely an entity is to require extraordinary support from a higher level of government in order to avoid default; Moody's (2007, page 2). Moody's (2009) attributes its dual rating system to the preferences of the highly risk averse investors in municipal bonds. In an earlier comment on the dual scales, Moody's (2002, page 11) reports that if municipal bonds were rated on the corporate scale, (1) nearly all general obligation (GO) and essential service revenue bonds would be rated Aa3 or higher and (2) GO bonds in default with anticipated full recovery would likely be rated Ba1.

[5] According to the MSRB in March 2014, approximately $3.7 trillion in municipal bonds finance public infrastructure projects; see http://www.msrb.org/Municipal-Bond-Market.aspx.

This mapping is time varying, however. Trzcinka (1982) examines municipal bond ratings from 1970-1979 and concludes that munis were, on average, more risky than corporates with the same rating. Cornaggia, et al. (2013) provide a comprehensive comparison of ratings by asset class and find that public finance bonds were significantly less risky than corporate bonds in each subsequent decade (1980s, 1990s, and 2000s). The dual class rating system persisted for decades until Moody's recalibrated its municipal ratings to align them with the Global Scale in April and May of 2010. The recalibration event was advertised in 2008.[6] Moody's (2010) clarifies that the ratings revision is intended to enhance the comparability of ratings across asset classes, not to indicate a change in fundamental credit quality:

> *"Our benchmarking analysis … will result in an upward shift for most state and local government long-term municipal ratings by up to three notches. The degree of movement will be less for some sectors … which are largely already aligned with ratings on the global scale. Market participants should not view the recalibration of municipal ratings as ratings upgrades, but rather as a recalibration of the ratings to a different scale … does not reflect an improvement in credit quality or a change in our opinion…"*

The recalibration was tentatively advertised to be implemented in stages over a four week period. The extent to which municipal bond market participants understood the planned recalibration and priced it ahead of time is an open question. Unlike the corporate bond market, which is dominated by institutional investors, households own 50% of the muni market.[7] Mutual funds are a distant second, holding 14%. (Rounding out the top five, money market mutual funds hold 10%, property-casualty insurance companies hold 9%, and U.S.-chartered depository institutions hold 7%.) Finally, and importantly for our study, Moody's (2010) indicates that any ratings under review for upgrade or downgrade prior to recalibration would remain under review – not lumped into these massive ratings changes. As such, our sample does not include any natural upgrades associated with improving issuer fundamentals that would contaminate the estimates generated by our tests.

[6] See "Moody's to Recalibrate its US Municipal Bond Ratings to the Company's Global Rating Scale" dated 9/2/08.

[7] In 2010, the household sector held $1.871 trillion of the $3.772 trillion municipal debt market. In contrast, households held 19% of corporate and foreign bonds; http://www.federalreserve.gov/releases/z1/current/z1.pdf.

B. Related Literature

Ramakrishnan and Thakor (1984) establish conditions under which information intermediaries such as rating agencies produce superior information relative to individual analysts. An assumption of their model is that intermediary compensation depends on performance. A rich literature examines the potential disconnect between compensation and performance in the case of rating agencies.[8] A related stream examines empirically the extent to which credit ratings inform markets.[9] This literature reports mixed results, but overall suggests that (1) markets move prior to rating agencies and (2) markets price ratings. Most authors conclude from point (1) that markets price information not reflected by the credit ratings. Conclusions from point (2) are more challenging because the rating changes (a) are correlated with changes in issuer fundamentals and (b) have regulatory and contractual implications (i.e., White, 2010; Ellul, et al., 2011; Bongaerts, et al., 2012; and Manso, 2013.)[10]

A complementary line of research considers the avenues by which credit ratings matter to issuing firms including access to capital, cost of capital, corporate capital structure, and investment decisions; see Hovakimian, et al. (2001), Faulkender and Petersen (2006), Kisgen (2006, 2009), Sufi (2009), Tang (2009), and Begley (2013). However, the impact of credit ratings on issuer cost of capital may reflect their regulatory implications (Kisgen and Strahan, 2010; Opp, et al. 2013) rather than their information content.

Researchers generally gauge the information content of ratings with horseraces of rating agencies against each other (Strobl and Xia, 2012; Cornaggia and Cornaggia, 2013; Xia, 2013), against quantitative models (Cornaggia, Cornaggia, and Xia 2013), or against securities markets

[8] Grossman and Stiglitz (1980) establish the conflict between the incentive to acquire and disseminate information. More recent theory and empirical work considers the conflict of interest inherent in the issuer-pays compensation structure; i.e., Partnoy (1999), Mathis, et al. (2009), Sangiorgi, et al. (2009), Skreta and Veldkamp (2009), Bolton, et al. (2012), He, et al. (2012), Jiang, et al (2012), Bar-Isaac and Shapiro (2013), and Bongaerts (2013).

[9] Examples include Hettenhouse and Sartoris (1976), Weinstein (1977), and Pinches and Singleton (1978), Ingram, et al. (1983), Holthausen, and Leftwich (1986), Hand, et al. (1992), Goh and Ederington (1993), Hite and Warga (1997), Ederington and Goh (1998), Dichev and Piotroski (2001), and Alp (2012).

[10] Regulators currently contemplate replacements for credit ratings in capital regulation following the Dodd Frank Act; see Becker and Opp (2013), Cornaggia, Cornaggia, and Hund (2013), and Hanley and Nikolova (2013).

(He, Qian, and Strahan, 2012; Bruno, et al., 2013). Jorion, et al. (2005) provide evidence on Moody's role as an information provider with an analysis of an exogenous change in regulation. These authors document an increased sensitivity of securities prices to ratings changes following Regulation Fair Disclosure (Reg. FD). Because rating agencies were exempt from Reg. FD, this regulation increased their relative importance in the market for information. (Dodd-Frank later repealed rating agencies' exemption and thus presumably ended this information advantage.)

The prior work most similar to ours is Kliger and Sarig (1999). These authors examine the change in Moody's corporate ratings to a more granular scale in 1982 and find that the ratings modifiers impact corporate bond yields. To our knowledge, theirs is the first evidence to show the impact of credit ratings free from confounding effects of contemporaneous changes in issuer fundamentals. However, the speed and ease with which the market can access and process information has increased substantially since 1982. As such, the question of rating agency relevance is again an open one. Moreover, Kilger and Sarig do not test the extent to which ratings provide new information versus impact regulatory demand for high-rated securities.

Other contemporaneous papers consider the real effects of credit ratings. Almeida, et al. (2013) exploit downgrades in sovereign credit ratings (which serve as ceilings for corporate bond ratings) and find that firms bound by these rating ceilings reduce investment and leverage. Kisgen (2012) examines changes in Moody's measurement of firm leverage and finds that firms most affected by new ratings methodologies alter their financing and investment behavior. Chen et al. (2014) find that yields declined on bonds classified as investment grade by Lehman Brothers after Lehman Brothers redefined its investment grade criteria.

Our work differs from these papers in several ways. First, although these papers exploit quasi-random changes in credit ratings, the scale of our setting is much larger and our tests have considerable power. We exploit a shift in the ratings of hundreds of thousands of bonds worth more than $2.2 trillion. Second, we are the first to construct tests that compare the effect of ratings that cross broad rating categories, and thus should have regulatory and contractual implications, to those that remain within broad rating categories. Finally, we focus on the municipal bond market. This distinction is important given the difference in information environment compared to the corporate bond and equity markets studied by other papers.

Ingram, Brooks, Copeland (1983) conclude that, "*financial accounting information about municipalities is generally less reliable, less comparable cross-sectionally, and less timely than information about corporations*" (page 997). This lack of transparency in the muni market has long resulted in price segmentation whereby smaller, presumably less sophisticated, investors pay higher prices than larger investors (see Harris and Piwowar, 2005, and Green, Hollifield, and Schurhoff, 2007). Although Schultz (2012) documents a reduction in price dispersion following the change in MSRB reporting requirements in 2005, the overall effect on markups along the inter-dealer network was small. To date, munis trade in opaque, decentralized, over-the-counter markets (e.g., Green, Li, and Schurhoff, 2010) and should thus benefit more from rating agencies as information intermediaries compared to corporate bonds and equities traded in liquid, transparent markets.

III. Data Collection and Sample Description

A. The Recalibration Event

Our municipal bond data consist of ratings from both Moody's and S&P, bond market transaction prices and volume from the MSRB, and issue/issuer characteristics from Ipreo. From Moody's, we collect ratings data on every bond issue by a state or local government that had a "Change in Scale" rating action on April 16, April 23, May 1, or May 7 in 2010, as well as the ratings on all past and future issues by the same issuers. Appendix A reports material describing the recalibration event. Table A.I presents the number of issues and cumulative par value of recalibrated uninsured, investment-grade munis.[11] Panel A contains all bonds with a "Change in Scale" rating action. Because the ratings of insured bonds reflect the credit quality of the

[11] Less than 1% of "Change in Scale" actions were associated with bonds that had speculative grade ratings, and none of these actions resulted in an upgrade. We discard these bonds for ease of presentation of the transition matrices and other results reported by rating. Including these observations does not alter any of our results.

monolines, we focus on uninsured bonds in our empirical analyses. Panel B contains the uninsured bonds from which we draw our sample.

The recalibration event of 2010 followed the monolines' loss of their Aaa ratings in June 2008. (S&P downgraded MBIA, Inc. and Ambac Financial Group, Inc. two notches to AA on June 6, 2008. Moody's downgraded MBIA (Ambac) five (three) notches to A2 (Aa3) on June 19, 2008.[12]) We thus consider the extent to which the composition of the muni markets (insured versus uninsured issues) during the recalibration event differs from historical norms in Appendix B. Panel A of Figure B.1 indicates that any impact of the changing insurance industry on municipal bond issuance occurred well prior to the recalibration event.

In March 2010, Moody's advertised a zero-to-three notch upgrade associated with the eminent recalibration. Table A.II reports the actual migration matrix for these recalibrated bonds. Again, Panel A contains all bonds and Panel B contains only the uninsured bonds from which we draw our sample. The proportion of bonds upgraded varies by initial rating. Other than Aaa rated bonds, which by definition cannot upgrade, no other initial rating level retained more than 50% of its original bonds.

Among uninsured bonds (Panel B), 54% of bonds rated Aa1 upgraded to Aaa. No other bonds reached the Aaa level. Approximately 57% of bonds originally in the A categories migrate into Aa categories and 64% of bonds in Baa categories migrated into A categories. Only 11 bonds were upgraded more than three notches (from A3 to Aa2). For the 9,714 issuers with multiple bonds outstanding at the time of recalibration, we examine (but do not tabulate) the within-issuer ratings distribution before and after the recalibration and find that these distributions remain largely intact.[13]

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[12] Sources: Reuter's (http://www.reuters.com/article/2008/06/05/bonds-insurers-sandp-idUSN0519442220080605) and Dow Jones (http://www.marketwatch.com/story/moodys-downgrades-aaa-rating-of-ambac-mbia).

[13] The within-issuer standard deviation of bond ratings averages 0.202 notches (0.206 notches) prior to (following) recalibration. The similarity of these standard deviations indicates that Moody's did not, for example, upgrade the lowest-or highest-rated bonds for each municipality. Rather, it indicates Moody's generally shifted upward the entire distribution of ratings for each issuer.

In Table A.III, we track post-recalibration rating actions (upgrades, downgrades, or affirmations) for uninsured bonds through the first year after recalibration and, for completeness, through the end of our sample. The summary statistics in this table shed light on the permanence of Moody's recalibration. Most recalibrated bonds do not appear in this table, indicating that their recalibrated ratings were permanent. Recalibrated bonds in our sample are subsequently upgraded (downgraded) at most two (three) notches in the year following recalibration. The average recalibrated bond is downgraded 0.019 notches in the subsequent year. We see some evidence that bonds with larger upgrades during recalibration experience larger subsequent downgrades. Among the bonds upgraded three notches, the average recalibrated bond is downgraded 0.113 notches in the subsequent year. Because the magnitudes of any downgrades are small relative to the preceding upgrades due to recalibration, the majority of rating actions are subsequently affirmed, and the vast majority of recalibrated bonds do not appear in Table A.III, we conclude that the recalibration event was permanent.

We further examine the permanence of Moody's recalibration by testing whether new bonds issued after recalibration have the same, higher ratings generated by the recalibration. Of the 3,190 issuers that issue bonds in both the year before and the year after the recalibration event, the average rating on their outstanding bonds changed from 17.1 (≈A1) to 18.3 (≈Aa3) as a result of the recalibration. The standard deviation of these ratings declined from 2.0 notches to 1.7 notches. Importantly, the new bonds (issued in the year after the recalibration event) exhibit the same average (18.3 ≈ Aa3) and standard deviation (1.7 notches) as the recalibrated bonds.[14] We thus conclude that Moody's applied its recalibrated ratings standards to new issues going forward after the recalibration, not just to bonds outstanding at that time.

B. Secondary Market Data

[14] We do not tabulate these results to conserve space. We employ a standard numerical transformation of Moody's rating scale ascending in credit quality (Aaa = 21, Aa1 = 20, …, C = 1).

We examine bond returns and trading volume in secondary markets around recalibration. We gather secondary market trading data from the MSRB Electronic Municipal Market Access (EMMA) database. The MSRB reports all trades of municipal bonds in the EMMA database. The transaction data include prices, dollar volume, trade time, and whether the transaction was a "Customer purchase," "Customer sale," or "Inter-dealer trade". No distinction is made in the data between retail and institutional customers. For transactions involving a "customer", the yield is also reported.[15] Municipal bond dealers include discount brokerages, full service brokerages, municipal advisors, and investment banks.[16]

C. New Issues Data

We gather data on new issues from the Ipreo i-Deal database including offer yield, sale date, maturity date, par value, coupon rate, as well as information on insurance and other support. We measure offer yields or spreads in three ways for completeness. First, *Offer yield* is the bond's raw offer yield. Second, *Spread to Treasury* is the difference between the raw offer yield and the yield on the maturity-matched Treasury security as of the date of issuance. Treasury securities have maturities of one, three, and six months, and one, two, three, five, seven, ten, 20, and 30 years. We match each municipal bond to the Treasury with the closest maturity. For example, if a municipal bond was issued on 1/1/2010 with a maturity of 8 years, we match it to the yield on the 7 year Treasury issued on 1/1/2010. This approach to measuring spreads is most common in financial economics literature, thus we feature it as our primary dependent variable. (However, as we will show, our inferences are robust to other measures of offer yields.) Third, *After-tax spread to Treasury* is the difference between raw offer yield and the after-tax yield on the maturity-matched Treasury security as of the date of issuance. We assume a marginal tax rate of 35%.

[15] The reported yield is the lower of the yield-to-call and the yield-to-maturity.

[16] See http://www.msrb.org/msrb1/pqweb/registrants.asp for a current list of MSRB registered broker-dealers.

Cestau, Green, and Schürhoff (2013) show that Build America Bonds (BABs) differ from traditional munis in their underpricing as well as their tax status. Because most BABs are taxable to the holder, we compute *After-tax spread to Treasury* as the difference between its after-tax offer yield and the after-tax yield of the U.S. Treasury bond with the closest maturity on the day of issuance.

For the same reason we exclude insured bonds in tests that use secondary market data, we exclude new issues that carry insurance in our tests based on primary market data.[17] Panel B of Figure B.1 (Appendix B) displays the dollar volume of insured and uninsured municipal bond issues by month from April 2009 to April 2011. We focus on this time period for two reasons. First, our multivariate regressions, which we explain below, use data from this time period. Second, it spans the BAB program, which ran from April 2009 to December 2010.[18] Uninsured bonds dominate this market over this time period.

IV. Empirical Results

A. Price Impact of Ratings Recalibration

We begin by studying the secondary market return behavior for outstanding bonds. This analysis allows us to focus on a narrow window around the event, which should limit the influence of any other contemporaneous events on prices and yields. Illiquidity in fixed income markets typically complicates abnormal bond return calculations. However, we find sufficient trading in our sample of munis around their recalibration to calculate CARs. During the 41 trading days in April and May of 2010, more than $300 billion of municipal bonds changed hands in more than one million transactions.

Table I indicates the magnitude of rating changes for the subsample of bonds for which we obtain secondary market data. For the first date, there are 1,135 bonds in the benchmark portfolio and 3,721, 364, and 887 bonds in the one-, two-, and three-notch portfolios,

[17] To the extent that insurance is a substitute for information disclosure (Gore, Sachs, and Trzcinka, 2003) the value of Moody's information production likely varies in this smaller set of insured bonds.

[18] Source: http://money.cnn.com/2010/12/22/news/economy/build_america_bonds/

respectively. In the final three dates, there are too few three-notch upgrades to estimate portfolio returns with any precision. The same is true of two-notch upgrades on the final date. There are fewer than 1,000 bonds in the remaining portfolios, with the exception of the zero-notch portfolio on the final date, which has 4,657.

[Insert Table I here.]

We calculate returns by trade-weighting as described by Bessembinder, et al. (2009).[19] In particular, we calculate the daily price, P_t, as

$$P_t = \sum_{i=1}^{N} \frac{tradesize}{\sum_{j=1}^{N} tradesize_j} price_i \qquad (1)$$

on days with at least one trade, and the most recent price on days with no trades. After trade-weighting the prices, we define returns, R_t, as

$$R_t = \frac{P_{t+1} - P_t}{P_t} \qquad (2)$$

For each of the four recalibration dates, and for one-, two-, and three-notch upgrades, we calculate CARs from 10 trading days before the event to 30 trading days after. We include only bonds that trade at least three times during this window. We form an equal weighted portfolio for zero-, one-, two-, and three-notch upgrades and calculate cumulative returns starting 10-days before the event date. We only include bonds that had an announcement on that date. We then calculate CARs by subtracting the zero-notch portfolio's cumulative return. To test significance, we perform a difference in means test under the assumption of different variances for the two averages.

Figure 1 plots the CARs for each of the three upgrade sizes as well as 95% confidence intervals for the first recalibration date – April 16. This is the most "clean" event of the four, as there is no overlap with the other three dates until trading day +5. This date also features the most upgrades of the four, giving the tests the most power. We observe significant positive

[19] Using corporate bond trading data, these authors show that calculating abnormal returns using trade-weighted prices increases the power of the test and reduces Type 1 errors relative to using end-of-day prices.

CARs following recalibrations resulting in upgrades. Post-recalibration CARs are nearly 40 basis points for munis upgraded one notch. This effect increases in the magnitude of the recalibration. Bonds upgraded two (three) notches due to recalibration experience CARs of 80 (140) basis points. There is some run-up before the event, suggesting market anticipation, but most of the increase comes after the event. These results contrast with those of Kadan, et al. (2009). These authors examine the scale adjustment by U.S. brokerage houses following the Global Analyst Research Settlement and find no price impact of the scale change. In contrast to Moody's change in rating standards, the brokerage houses alter their scales from granular to coarse.

[Insert Figure 1 here.]

Next, we explore the extent to which this observed pricing impact is a result of the information content of the credit rating, as distinct from the regulatory demand (i.e., higher credit ratings translate into lower reserve requirements and other costs associated with regulatory or contractual compliance). If compliance costs fall as a result of the upgrade, then we should expect increased demand for the upgraded bonds irrespective of their credit risk. Because the greatest regulatory and contractual consequences are associated with the investment grade cutoff (Baa3 is Moody's lowest investment grade rating), and because our sample of municipal bonds are investment grade, we expect that the observed price impact reflects information provision.[20]

However, there are some regulatory considerations across the investment grade categories in our sample. Ratings thresholds vary by regulator, but in general crossing broad ratings categories have greater consequences than moving a notch or two within a broad category.[21] To disentangle potential regulation-based demand shift from information effects, we

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[20] Capital charges established by the National Association of Insurance Commissioners (NAIC) range from 3.39% to 19.5% for speculative grade bonds compared to a range of 0.30% to 0.96% for investment grade bonds; see Becker and Ivashina (2013). Pension funds also face limitations in holding speculative grade bonds; see Ellul, et al. (2011). Beyond official regulation, private investment mandates, asset management policies, and informal procedures restrict holdings of speculative grade bonds for mutual funds and investment advisors; see Chen, et al. (2014).

[21] NAIC guidelines treat Aaa, Aa, and A similarly, but charge more than three times the capital for the lowest investment grade rating category (Baa1 – Baa3). Under Basel guidelines, single A rated bonds carry a higher charge than Aa or Aaa; details available here: www.bis.org/publ/bcbs128b.pdf. The SEC treats only Aaa rated bonds as equivalent to cash or government securities under Rule 5b-3 of the Investment Company Act. (SEC rule

consider separately the one-notch upgrades that migrate across a regulatory threshold into a new broad rating category (e.g., from Baa1 to A3) and the one-notch upgrades that remain within their original broad rating category (e.g., from A2 to A1). Focusing on one-notch upgrades ensures that any differences in estimates are not driven by differences in upgrade magnitudes. (All else equal, an upgrade that crosses a broad rating category likely moves more notches than an upgrade that remains within a broad rating category.) Figure 2 plots the CARs separately for these two types of one-notch upgrades along with 95% confidence intervals for the April 16 recalibration date. Both sets of CARs are positive and statistically significant. The group crossing into a new broad rating category exhibits higher average CARs, however the confidence intervals of these two groups overlap. As such, we cannot dismiss information provision as the channel by which ratings impact bond prices.

[Insert Figure 2 here.]

B. Trading Volume

As a further test of the regulatory channel versus the information channel, we consider differences in trading volume around the recalibration event. Restricting our attention to upgraded bonds, we examine the effect of crossing a regulatory threshold (i.e., a broad rating category) on trading volume in a difference-in-differences framework. For each bond that had at least one trade in the month before or after its recalibration, we calculate the average daily trading volume during the 20 trading days before and after the event coming in the form of "Inter-dealer trades", "Customer purchases" and "Customer sales" as classified by the MSRB. In some cases, this number is zero. To capture the regulatory effect, we define the variable *New broad rating category* and set it equal to one if the bond upgraded from below Aaa to Aaa, from below Aa3 to at least Aa3 and from below A3 to at least A3, and zero otherwise. To capture the general effect of the upgrade, we set the variable *Post recalibration* to zero before the event and one after. We pool all 4 events together and conduct a difference-in-differences regression using

proposals following the Dodd-Frank Act intended to reduce the regulatory reliance on ratings occur after our sample and test period.)

the log of (1 plus) average trading volume for each of the measures. We estimate the regression separately for bonds that had upgrades of one notch and two notches. Table II displays the results.

[Insert Table II here.]

There are a total of 45,834 bonds that were upgraded one notch and had at least one trade during this period. There is a positive, statistically significant increase in trading volume for both inter-dealer trades and customer purchases of upgraded bonds that crossed a regulatory threshold relative to those that did not. For the typical bond in the sample, that difference represents an increase in trading volume of about 23% for inter-dealer trades and 32% for customer purchases.[22] There is no statistically significant differential effect on customer sales for one-notch upgrades. These results suggest that increased demand from regulated investors cause some of the upward price pressure as a result of the upgrades. For larger upgrades, the effect is even stronger. Trading volume for inter-dealer trades is roughly 57% higher for bonds with two-notch upgrades that cross a regulatory threshold than for their counterparts that remain within broad rating categories. The difference in trading volume for customer purchases is even more dramatic at 166%.

C. Evidence from New Issues

In the preceding tests of secondary market prices and trading volume, our treatment and control groups consist of recalibrated bonds. In this section, we define treatment and control groups at the municipality level. Specifically, the treatment group contains new issues by municipalities whose outstanding bonds were recalibrated up at least one notch. The control group contains new issues by municipalities whose bonds were recalibrated zero notches (i.e., bonds with a "Change in Scale" rating action of zero notches).

[22] The estimated percentage change in Y that results from changing a dummy variable D in the linear, log-levels regression, $\log(Y) = a + b\times X + c\times D$, is $\exp(c) - 1$, where c is the coefficient on the dummy variable. This result obtains from taking the exponential of both sides of the equation, which yields $Y = \exp(a + b\times X + c\times D)$, and then calculating the percentage change associated with moving from Y evaluated at $D = 0$ to Y evaluated at $D = 1$. For the case of one-notch upgrades that cross a regulatory threshold, volume increases by about $\exp(0.21) - 1 = 23\%$.

We measure offer yields and spreads in three ways: *Offer yield*, *Spread to Treasury* and *After-tax spread to Treasury*, as defined above. Yields and spreads vary over time for a host of reasons other than the credit quality of the issuer, but these factors should affect the interest rate environment for both the treatment and control groups. Figure 3 plots the average offer yields and spreads for new bonds issued by municipalities whose outstanding bonds were upgraded as a result of recalibration and municipalities whose outstanding bonds were not upgraded during recalibration. These are our treatment and control groups, respectively, and the plots center around April 2010, the month with the first and most numerous recalibrations. Yields and spreads for the two groups were not consistently or predictably different prior to the event. This pattern indicates that our setting satisfies the parallel trends assumption, a necessary condition for reliable inferences from a difference-in-differences estimate. Figure 3 also indicates that the parallel trends between the treatment and control groups cease precisely in April 2010 and the treatment group has consistently lower yields and spreads after recalibration. This figure provides preliminary evidence that Moody's recalibration lowered the future cost of financing for upgraded municipalities.[23]

[Insert Figure 3 here.]

Table III displays summary statistics for the sample of uninsured bonds for which we have complete data for multivariate tests. Panel A reports summary statistics separately for the subsamples of bonds bifurcated by whether the issuer's bonds were upgraded as a result of the recalibration. We employ a standard numerical transformation of Moody's rating scale ascending in credit quality (Aaa = 21, Aa1 = 20, …, C = 1). However, as noted above, our sample contains only investment grade bonds (rated Baa3 or higher). Given the Aaa upper bound, the average upgraded issuer received a slightly lower rating at issuance (18.5 ≈ Aa2) than the average bond that retained its rating through recalibration (19.3 ≈ Aa2). Conditional on an upgrade, the average upgrade was 1.3 notches resulting in an average (19.9 ≈ Aa1) higher than the control

[23] Moody's recalibrated bond ratings, not issuer ratings. We use the term "upgraded municipalities" to refer to municipalities for which outstanding bonds were recalibrated up at least one notch.

group. The variable *Notches* is not directly comparable to the transition matrix in Table A.II, which shows individual bonds' ratings immediately before and after recalibration. In contrast, Table III displays the distribution of an issuer-level variable (*Notches)* measuring the difference in average ratings of issuer debt before and after recalibration. We note the differential proportion of general obligation bonds in these two subsamples: 60% of new issues by upgraded municipalities are GO, compared to 34% of new issues by the control group. The proportions of BABs are similar between the groups: 18% (19%) of bonds issued by municipalities without (with) a rating change due to recalibration are BABs. Among all BABs in our sample, 45% are GO. Among all bonds in our sample that are not BABs, 51% are GO.

[Insert Table III here.]

The average *Offer yield* (3.08 percent) for the subsample of new issues by upgraded municipalities is similar to the control group (3.11 percent). Due to preferential tax treatment, municipal bonds commonly have negative nominal yield spreads. Municipal bond yield curves commonly intersect Treasury bond yield curves at various points and even *After-tax spread to Treasury* is negative in over 25% of our sample.[24]

Table III Panel B reports summary statistics separately for issues in the year prior to recalibration and the subsequent year. Our sample contains virtually identical proportions of GO bonds issued before (50%) and after (49%) recalibration. The proportions of BABs are also similar between the groups: 19% (18%) of bonds issued prior (issued after) recalibration are BABs. The average offer yield (and spread) is lower in the later time period. Because both yields and spreads are time varying, we cannot infer an impact of the recalibration from this observation. To test the impact of the recalibration on the pricing of the new issues, we employ a difference-in-differences framework in Table IV. This approach provides a statistical test of the patterns observed in Figure 3 while also controlling for a host of issue characteristics and fixed effects.

[24] For December 2013 yield curves, see "Municipal Bond Market Weekly" published 12/9/13 by R.W. Baird & Co.

The dependent variables in Table IV regressions are *Offer yield*, *Spread to Treasury*, and *After-tax spread to Treasury*. The dummy variable *Upgrade* takes a value of one if the issuer of the bond experienced an upgrade on any of its outstanding bonds during any of the recalibration events and zero if the issuer's bonds experienced zero-notch "Change in Scale" rating actions. *Post recalibration* is a dummy variable taking a value of one if the bond was issued in the year after the issuer's bonds were recalibrated by Moody's, and zero if the bond was issued in the year prior to the recalibration events. Importantly, we only include bonds issued by municipalities that issue new bonds both in the year before and the year after the recalibration events. We apply this filter to mitigate selection bias, whereby upgraded municipalities may disproportionately participate in the sample after recalibration.

The interaction terms reported in the top row indicate that after recalibration, *Offer yield*s on new debt issues for the treatment group decline significantly by nine to 13 basis points relative to the control group. *Spread to Treasury* declines significantly by 16 to 17 basis points and *After-tax spread to Treasury* declines 14 to 16 basis points. We control for bond characteristics (par, maturity, coupon, liquidity), issuers' average ratings in the pre- or post-recalibration period, and issuance geography or issuer fixed effects.[25] Binary variables indicate that GO bonds have significantly lower yields and spreads relative to revenue bonds or other types of bonds. BABs have significantly higher *Offer yield* and *Spread to Treasury*, but lower *After-tax spread to Treasury*.

[Insert Table IV here.]

The coefficient on *Upgrade* is negative and significant in columns (1), (4), and (7). These regressions control for issuers' average ratings in the pre-recalibration period. These negative coefficients imply the market understood that soon-to-be-upgraded municipalities were more creditworthy than like-rated municipalities whose ratings did not change due to recalibration. Further, in columns (5) and (8), we observe positive and weakly significant coefficients on

[25] We include either issuer fixed effects or state of issuer fixed effects, but not both. Issuer fixed effects subsume state fixed effects.

Upgrade. These regressions control for issuers' average ratings in the post-recalibration period. Although the effect is faint, these positive coefficients indicate the market has a memory. In other words, market participants do not view the creditworthiness of municipalities whose ratings were upgraded due to recalibration to be the same as municipalities that already had the ex post ratings.

In lieu of the binary indicator *Upgrade*, Panel B of Table IV captures the effect of the recalibration on offer yields with *Notches*, the difference between *Issuer rating post-recalibration* and *Issuer rating pre-recalibration*, rounded to the nearest whole number. Consistent with our results from the secondary market, we find that the effect is larger in magnitude for municipalities whose bonds experienced larger upgrades. For each notch a municipality's outstanding bonds are upgraded during recalibration, its new issues experience *Offer yields* that are nine to 12 basis points lower than those of the control group. For each notch of upgrade, *Spread to Treasury* is lower than the control group by 13 to 14 basis points. This result implies that a municipality whose bonds were upgraded three notches would enjoy spreads 39 to 42 basis points lower than a similar municipality whose ratings were not upgraded.

Results in both panels of Table IV are marginally stronger (i.e., the coefficient on the interaction term is larger) in the models controlling for either the issuer rating level pre- or post-recalibration, both of which are significantly negatively related to offer yields and spreads on new issues. Because our numeric transformation of ratings is increasing in credit quality (i.e., Aaa = 21 and C = 1) these negative coefficients confirm that offer yields and spreads are lower for issuers of higher credit quality gauged either before or after the recalibration. Overall, we conclude from the multivariate analysis in Table IV that the recalibration of municipal bonds had a significant impact on the pricing of subsequent municipal debt issues.

In the interest of conserving space, we only report regressions with *Spread to Treasury* as the dependent variable starting in Table V. (Results from regressions using *Offer yield* and *After-tax spread to Treasury* as the dependent variable are consistent, as they were in Table IV. These results are available on request.) In Table V, we repeat the regression analysis in Table IV after conditioning on issuers' average credit ratings in the pre-recalibration and, separately, post-recalibration periods. This analysis allows us to determine whether our results are widespread, or simply driven by issuers initiating in or ending up in a particular rating category. We find that the negative and significant coefficient on the interaction term remains in two of three subsamples whether we split the sample by initial or final issuer rating. However, we observe a positive and significant coefficient on the interaction term for bonds whose issuers had average ratings in the Baa-range prior to recalibration. This result could reflect a small sample bias. Indeed, the sample from which this result derives contains only 956 bonds. Further, Panel B indicates this unusual result may be driven by outliers. In Panel B, we use the magnitude of the upgrade to capture the recalibration effect, instead of a simple dummy variable indicating whether or not the bond's issuer was upgraded during recalibration. The coefficient on the interaction term in column (1) in Panel B is no longer significant. Overall, the results in Table V indicate that the baseline results reported in Table IV are stronger for the bonds migrating out of the A and Aa ranges than out of the lower Baa range.

[Insert Table V here.]

E. Why Do Ratings Affect Offer Yields?

Like the secondary market tests, we test for the influence of regulatory and contractual demand versus information effects as the channel through which ratings affect bond prices. Table VI restricts the treatment sample in Table V to bonds issued by municipalities whose outstanding bonds upgraded one-notch during recalibration. We compare new issues by upgraded municipalities whose upgrades cross a broad rating category (columns 1 through 3) to those that remain within the original broad category (columns 4 through 6). Focusing on one-notch upgrades ensures that any differences in coefficient estimates are not driven by differences in upgrade magnitudes. We find a difference-in-differences estimate of 22 basis points for municipalities whose bonds were upgraded into a new broad rating category. This estimate is larger than the baseline 16-to-17 basis point effect documented in Table IV. This finding indicates that upgrades associated with a reduction in compliance costs have a greater price impact than upgrades that do not increase regulatory demand. However, the price impact (11 basis points) observed among the upgrades without regulatory consequences remains significant at 1%. The finding suggests that a significant portion of the price impact is attributable to information provision.

[Insert Table VI here.]

F. Differences in Information Environments

We posit early in the paper that because the municipal bond market is relatively opaque, rating agencies could be an especially important information intermediary in this market. Indeed, our results from both the secondary markets and initial issues indicate an information effect of Moody's credit ratings. We further test this information hypothesis in Table VII by comparing the relevance of Moody's ratings across different information environments within the broad class of municipal issuers. Specifically, we separate our sample of municipal issuers according to various measures of issuer opacity and repeat our primary multivariate regressions of *Spread to Treasury* on the interaction term and control variables from Table IV. In the interest of conserving space, we report only the models which control for the *Issuer rating pre-calibration* (However, all of these results are robust to the alternative of controlling for *Issuer rating post-recalibration*.)

[Insert Table VII here.]

We begin by splitting the treatment sample by issuer level of government. If credit ratings provide information, then the recalibration event should have a larger impact among the smallest, most opaque issuers. Columns (1), (2), and (3) contain results after restricting the treatment sample to bonds issued by states, counties, and cities, respectively. We discard bonds from issuers that do not cleanly fit into one of these three categories (e.g., bonds issued by special tax districts). The first three columns of Table VII indicate that the recalibration effect captured by the interaction term is weakest among states (5 basis points) and strongest among cities (27 basis points). The magnitude of the coefficient for counties lies between these two estimates and is similar to the overall sample in Table IV (16 basis points, significant at 1%).

Columns (4) and (5) bifurcate the sample based on a measure of corruption risk provided by the State Integrity Investigation (SII).[26] Butler, et al. (2009) document that higher state corruption is associated with greater credit risk and bond yields. Our question is whether the impact of Moody's recalibration is thus more important among corrupt states. We ascribe the state-level measure provided by SII to all municipal issuers within the state. We bifurcate by the median corruption risk score (70). Both groups indicate a significant impact of recalibration on the cost of new issues, however the difference-in-differences coefficient is stronger (19 basis points, significant at 1%) for the high risk group than for the low risk group (14 basis points, significant at 5%).

We follow a similar approach in columns (6) and (7) and divide the treatment sample by issuer opacity, as gauged by the U.S. Public Interest Research Group (U.S. PIRG).[27] Again, we ascribe this state-level measure to all municipal issuers within a state and bifurcate by median opacity score (73). The coefficient of interest is stronger for the high opacity group (22 basis points) than the low opacity group (12 basis points) although both are significant at 1%.

Finally, we consider in columns (8) and (9) whether the upgraded issuers are also rated by Standard and Poor's (S&P). Butler (2008) argues that nonrated bonds are harder for underwriters to sell. Although all of the bonds in our sample are rated by Moody's, to the extent that ratings matter for pricing new debt, the information provided by Moody's should be especially important when S&P does not provide a rating. Thus, we expect that the difference-in-

[26] The corruption risk index is a snapshot from 2013. We assume the corruption risk for any particular municipality is highly correlated over our sample period. Corruption risk measures are available at http://www.stateintegrity.org/your_state.

[27] The U.S. PIRG ranks the 50 states according to the extent to which they provide online access to government spending data. The opacity index is from 2010; we assume this measure of opacity for any particular state is highly correlated across our sample period. Opacity scores are available at http://www.uspirg.org/sites/pirg/files/reports/Following%20the%20Money%202011%20vUS.pdf

differences effect should be stronger among bonds issued by municipalities that are not rated by S&P. Indeed, the coefficient on the interaction term is stronger for the group not rated by S&P (20 basis points compared to 16), although both remain significant at 1%.

In untabulated results, we conduct three regressions after separately pooling the subsamples in columns (4) and (5), (6) and (7), and (8) and (9). We construct a dummy variable *Opaque* that takes a value of one for bonds in the high opacity subsamples (columns (5), (7), and (9)) and zero for bonds in the low opacity subsamples. We interact this variable with *Post-recalibration* × *Upgrade* and replicate our regression on the pooled samples. This triple-differences approach allows us to formally test whether the stronger effects visible in columns (5), (7), and (9) are statistically different from their low-opacity-subsample counterparts. Although the coefficients' signs on the triple interaction terms indicate that Moody's ratings are more influential in low-information environments, the coefficients are not significant. As such, we conclude that the results reported in Table VII provide only supportive evidence that the relevance of Moody's ratings is stronger among especially opaque issuers.

D. Did Municipalities Capitalize on their Upgraded Credit Ratings?

If higher bond ratings reduce borrowing costs, then newly upgraded municipalities should enjoy increased debt capacity. We find evidence that this is indeed the case. Untabulated results indicate that upgraded municipalities issue 12.5% more bonds in the year after recalibration relative to non-upgraded municipalities. Specifically, non-upgraded municipalities issue 9.2% fewer bonds in the year after recalibration, whereas upgraded municipalities issue 3.3% more bonds. In dollar volume, both groups issue less debt, but the reduction in dollar volume is smaller for upgraded municipalities. Non-upgraded municipalities issue 24.1% less dollar volume, whereas upgraded municipalities issue only 15.9% less dollar volume.

Figure 4 plots the dollar volume of new issues for the treatment and control samples we use in our baseline multivariate regressions. We observe that municipal issues reach their in-sample peak six months following the recalibration event – but only for the treatment group. This uptick indicates that upgraded municipalities capitalized on their higher credit ratings.

[Insert Figure 4 here.]

V. Did Standard & Poor's also Recalibrate its Ratings?

Our focus thus far has been on the behavior of Moody's ratings and how the company's recalibration affected the pricing of municipal debt. However, given that Moody's and S&P are similar in size and together dominate the ratings industry, it is natural to ask whether and to what extent S&P responded to Moody's recalibration by changing its municipal ratings. Unlike Moody's, S&P has long maintained that it never had a dual-class rating system:

> *"We have always had one scale, a consistent scale that we have tried to adopt across all our asset classes."*
>
> -- Deven Sharma, President, Standard & Poor's (S&P), July 27, 2011[28]

Therefore, if S&P's municipal ratings were already on the same scale as corporate and sovereign bonds, S&P should not update its ratings around the time Moody's recalibrated.

We examine S&P's ratings around the time of Moody's recalibration in Table VIII. Panel A contains our full sample of municipal bonds rated by S&P, irrespective of whether they were rated or recalibrated by Moody's. We observe ratings at two points in time for these bonds. The horizontal axis corresponds to S&Ps ratings on April 16, 2010 (i.e., Moody's first recalibration date). The vertical axis corresponds to S&P's ratings on the date of its next rating change or April 16, 2011, whichever comes first. In other words, if S&P does not update a bond's rating within one year of Moody's recalibration, the bond remains on the main diagonal of the transition matrix.

[Insert Table VIII here.]

The transition matrix reported in Panel A does not suggest an upward migration of S&P ratings over this one-year time horizon to mirror Moody's recalibration. The overwhelming

[28] Testimony before the U.S. House of Representatives, Committee on Financial Services, Oversight and Investigations Subcommittee, 2129 Rayburn Office Building, Washington DC, July 27, 2011.

majority of S&P-rated munis retain their original ratings. However, S&P exhibits an unusual proclivity for updating the bonds' ratings to AA+. This shift applies to bonds downgraded from AAA, as well as bonds with lower starting ratings (some upgraded as many as eight notches from BBB-). The total number of issues rated AA+ increased from 26,582 to 32,349 (an increase of 21.7%) in the year following Moody's recalibration.

We repeat this transition matrix in Panel B after restricting the sample to bonds that Moody's recalibrated (i.e., the sample of bonds in Table A.II Panel B). The migration toward AA+ is evident here as well, if less pronounced (an increase of 6.8% from 17,451 to 18,630 bonds). The migration toward AA+ is strongest (a 50% increase from 9,131 to 13,719 bonds) in Panel C which displays the one year migration of S&P's ratings for the sample of bonds not rated or recalibrated by Moody's.

Overall, we conclude from Table VIII that although S&P did not announce any formal recalibration of its municipal bond rating scale it did revise a massive number of municipal ratings toward the AA+ rating category. We cannot attribute these results to simultaneous ratings changes in the monolines for two important reasons. First, we include only uninsured bonds in our analysis. Second, mechanical ratings changes following the downgrades of monolines would predict only the downgrades from AAA to AA+, not the upward migration from lower ratings categories (as many as 8 notches up from BBB-).

VI. Conclusion

We exploit Moody's recalibration of its dual-class rating system to shed light on the information environment in the $3.7 trillion municipal bond market, the extent to which credit ratings affect market prices, the channels by which ratings affect prices, and the real economic effects of Moody's credit ratings. We find robust evidence that Moody's dual class ratings system resulted in higher borrowing costs to taxpayers compared to those enjoyed by corporations and other asset classes with similar credit quality. We estimate that the dual-class rating standards cost taxpayers an aggregate $1.03 billion annually in excess interest on recalibrated bonds. This estimate is comparable to the $4 billion cost to taxpayers (over a 14 year period) associated with advanced refunding of municipal debt, as estimated by Ang, Green, and Xing (2013). This estimated cost associated with incomparable ratings scales is timely as the SEC (2011) considers the Dodd-Frank mandate to standardize credit ratings across all rated securities (see §938).

The price impact of Moody’s ratings on outstanding bonds and new issues appears driven in part by regulated institutions mitigating compliance costs. However, we find significant reduction in offer yields and credit spreads among the marginally upgraded municipalities that do not cross a regulatory threshold. We also find evidence that the price impact of Moody’s recalibration is largest among especially opaque issuers. We conclude that Moody’s ratings continue to play a significant role in the market for information and have real effects on the price and quantity of municipal bond issues.

Appendix A: Supplemental Material Describing Moody's Recalibration

Table A.I
Number and Par Values of Recalibrated Bonds

This table displays the number and total par value of municipal bonds for which Moody's issued a "Change in Scale" rating action between April 16, 2010 and May 7, 2010. Panel A includes all bonds rated by Moody's. Panel B restricts the sample in Panel A to uninsured bonds. We collect ratings data on bonds issued by state or local governments from Moody's.

Panel A: All Bonds

	All "Change in Scale" rating actions		"Change in Scale" results in an upgrade		"Change in Scale" results in no change in rating	
Recalibration date	N bonds	Total par	N bonds	Total par	N bonds	Total par
April 16, 2010	213,260	$932.8 billion	190,144	$812.5 billion	23,116	$120.4 billion
April 23, 2010	201,962	$312.9 billion	186,946	$281.2 billion	15,016	$31.7 billion
May 1, 2010	124,053	$249.9 billion	108,046	$199.4 billion	16,007	$50.6 billion
May 7, 2010	105,855	$715.2 billion	24,221	$67.4 billion	81,634	$647.8 billion
Sum	645,130	$2,210.8 billion	509,357	$1,360.5 billion	135,773	$850.5 billion

Panel B: Uninsured Bonds

	All "Change in Scale" rating actions		"Change in Scale" results in an upgrade		"Change in Scale" results in no change in rating	
Recalibration date	N bonds	Total par	N bonds	Total par	N bonds	Total par
April 16, 2010	90,621	$566.3 billion	72,213	$466.0 billion	18,408	$100.3 billion
April 23, 2010	55,891	$96.8 billion	42,769	$70.5 billion	13,122	$26.4 billion
May 1, 2010	54,021	$117.2 billion	40,550	$72.3 billion	13,471	$44.9 billion
May 7, 2010	65,510	$461.2 billion	8,944	$31.5 billion	56,566	$429.6 billion
Sum	266,043	$1,241.5 billion	164,476	$640.3 billion	101,567	$601.2 billion

Table A.II

Ratings Migration Matrix for Moody's "Change in Scale" Rating Actions

This table displays migration matrices on underlying ratings for municipal bonds for which Moody's issued a "Change in Scale" rating action. Panel A includes all bonds rated by Moody's. Panel B restricts the sample in Panel A to uninsured bonds. The horizontal axis represents bonds' ratings before the first recalibration date (April 16, 2010) and the vertical axis represents the bonds' ratings after the fourth and final recalibration date (May 7, 2010). We collect ratings data on bonds issued by state or local governments from Moody's.

Panel A: All Bonds

		Rating before scale change										
		Aaa	Aa1	Aa2	Aa3	A1	A2	A3	Baa1	Baa2	Baa3	Sum
	Aaa	47,917	27,164									75,081
	Aa1		20,412	70,503	45	50						91,010
	Aa2			19,405	114,519	74,029		11				207,964
Rating	Aa3				11,802	23,403	79,338	36				114,579
after	A1					10,997	12,304	58,818	22,040			104,159
scale	A2						9,930	5,901	1,570	12,246		29,647
change	A3							7,591	1,617	341	2,334	11,883
	Baa1								2,707	159	2,764	5,630
	Baa2									3,072	153	3,225
	Baa3										1,952	1,952
	Sum	47,917	47,576	89,908	126,366	108,479	101,572	72,357	27,934	15,818	7,203	645,130

Panel B: Uninsured Bonds

		Rating before scale change										
		Aaa	Aa1	Aa2	Aa3	A1	A2	A3	Baa1	Baa2	Baa3	Sum
	Aaa	46,828	20,404									67,232
	Aa1		17,579	40,536	5	29						58,149
	Aa2			14,204	43,229	14,620		11				72,064
Rating	Aa3				6,413	7,009	14,098	16				27,536
after	A1					4,321	3,560	9,838	4,525			22,244
scale	A2						4,333	1,418	598	2,245		8,594
change	A3							3,575	449	87	1,042	5,153
	Baa1								1,502	81	614	2,197
	Baa2									1,758	74	1,832
	Baa3										1,042	1,042
	Sum	46,828	37,983	54,740	49,647	25,979	21,991	14,858	7,074	4,171	2,772	266,043

Table A.III
Subsequent Rating Actions after Recalibration

This table displays summary statistics on the rating actions (upgrades, downgrades, or affirmations) subsequent to recalibration for uninsured municipal bonds. A bond's rating must update again after a "Change in Scale" rating action for inclusion to this table. We report the difference in the new rating and the rating produced by the recalibration, measured in notches. A positive (negative) difference indicates a subsequent upgrade (downgrade). Zero difference indicates that the recalibrated rating was subsequently affirmed. The sample ends in October 2012. We translate Moody's 21-point alphanumeric scale into a numeric scale such that Aaa = 21, Aa1 = 20, ..., C = 1. We collect ratings data on bonds issued by state or local governments from Moody's.

Panel A: Rating Differences

	N bonds	Mean	SD	Min	25%	Median	75%	Max
All bonds with rating updates after recalibration	22,788	-0.021	0.217	-3	0	0	0	3
Bonds with rating updates within one year after recalibration	20,469	-0.019	0.200	-3	0	0	0	2

Panel B: Rating Differences Split by Size of Upgrade due to Recalibration

	N bonds	Mean	SD	Min	25%	Median	75%	Max
All bonds with rating updates after recalibration								
No change	9,077	0.006	0.172	-2	0	0	0	3
1 notch	10,160	-0.018	0.188	-3	0	0	0	1
2 notch	2,909	-0.098	0.329	-2	0	0	0	1
3 notch	642	-0.112	0.391	-2	0	0	0	2
Bonds with rating updates within one year after recalibration								
No change	7,761	0.006	0.144	-2	0	0	0	2
1 notch	9,391	-0.011	0.165	-3	0	0	0	1
2 notch	2,688	-0.098	0.319	-2	0	0	0	1
3 notch	629	-0.113	0.393	-2	0	0	0	2

Appendix B: Supplemental Material Describing the Municipal Bond Market

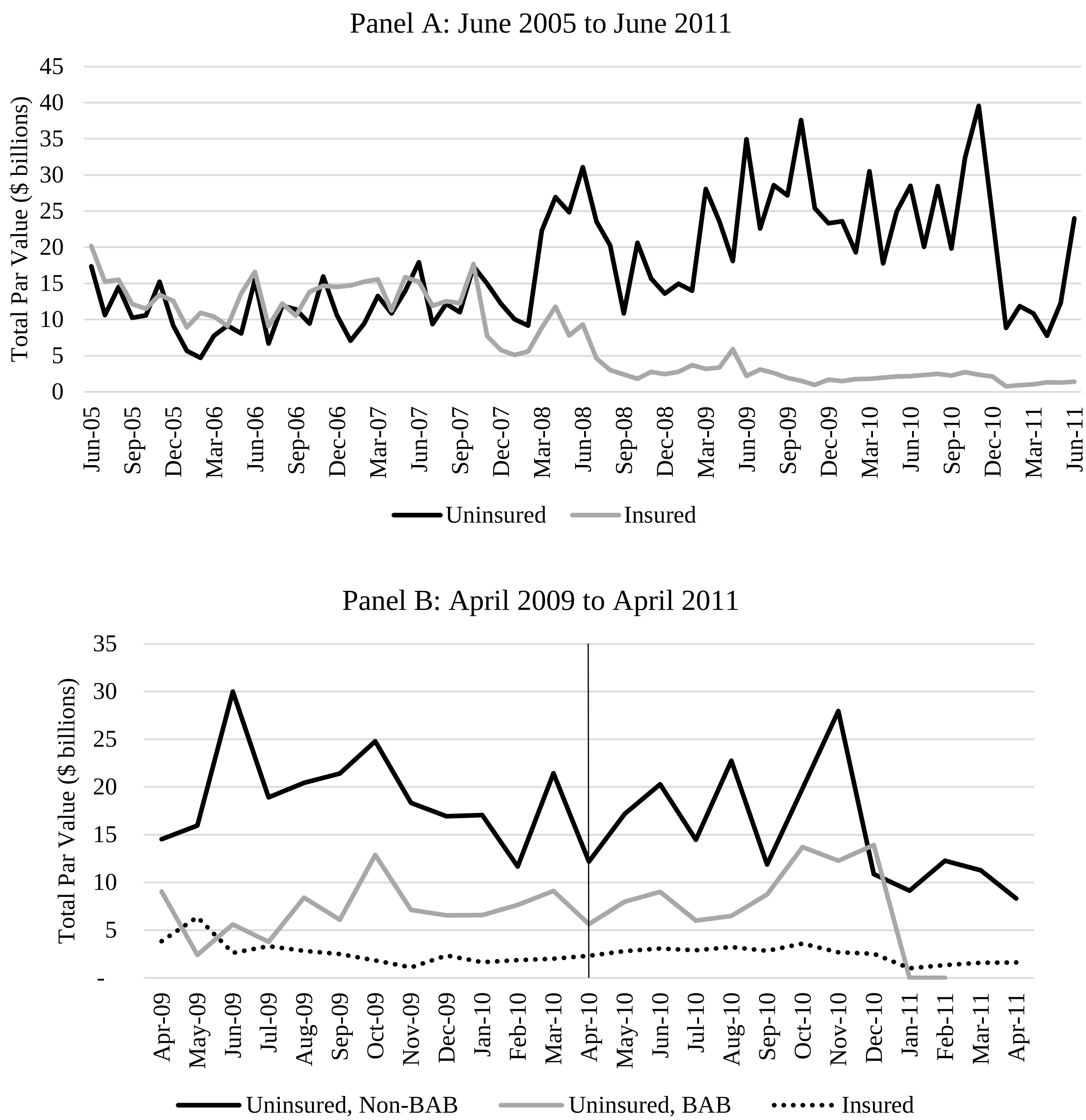

Figure B.1. Dollar volume of issues per month. Panel A displays the total par value of Moody's-rated municipal bonds issued per month over a six-year period (June 2005 to June 2011) centered on June 2008. We split the sample by whether the bonds are wrapped with third-party insurance. Panel B displays the total par value of Moody's-rated municipal bonds issued per month over the time horizon we use in our multivariate regressions (April 2009 to April 2011). We split the sample by whether the bonds are wrapped with third-party insurance. We further split the uninsured bonds by whether they are Build America Bonds. The vertical line denotes April 2010, the month with the first and most numerous recalibrations. The data come from the Ipreo i-Deal new issues database.

References

Almeida, H., Cunha, I., Ferreira, M.A., and Restrepo, F., 2013, The real effects of credit ratings: Using sovereign downgrades as a natural experiment, working paper.

Alp, Aysun, 2013, Structural shifts in credit ratings, *Journal of Finance*, forthcoming.

Ang, A., Green, R.C., and Xing, Y., 2013. Advance refunding of municipal bonds, working paper.

Bar-Isaac, H., and Shapiro, J., 2013. Ratings quality over the business cycle, *Journal of Financial Economics* 108(1), 62-78.

Becker, B., and Ivashina, V., 2012. Reaching for yield in the bond market, *Journal of Finance* forthcoming.

Becker, B., and Opp, M. 2013. Replacing ratings, working paper.

Begley, T.A., 2013. The real costs of corporate credit ratings, working paper.

Bessembinder, H., Kahle, K.M, Maxwell, W.F., and Xu. D., 2009. Measuring abnormal bond performance. *Review of Financial Studies* 22(10), 4219-4258.

Bolton, P., Freixas, X., and Shapiro, J., 2012. The credit ratings game, *Journal of Finance* 67(1), 85-112.

Bongaerts, D., 2013. Can alternative business models discipline credit rating agencies? working paper.

Bongaerts, D., Cremers, M., and Goetzman, W., 2012. Tiebreaker: certification and multiple credit ratings, *Journal of Finance* 67(1), 113-152.

Boot, A.W.A., Milbourn, T.T., and Schmeits, A., 2006. Credit ratings as coordination mechanisms, *Review of Financial Studies* 19(1), 81-118.

Bruno, V., Cornaggia J., and Cornaggia K. J., 2013. Does regulatory certification affect the information content of credit ratings? working paper.

Butler, A. W., 2008, Distance still matters: Evidence from municipal bond underwriting, *Review of Financial Studies* 21(2), 763-784.

Butler, A.W., Fauver, L., and Mortal, S., 2009. Corruption, political connections, and municipal finance, *Review of Financial Studies*, 22(7), 2673-2705.

Cestau, D., Green, R., and Schürhoff, N., 2013. Tax-subsidized underpricing: Issuers and underwriters in the market for Build America Bonds, *Journal of Monetary Economics*, forthcoming.

Chen, Z., Lookman, A. A., Schürhoff, N., and Seppi, D. J., 2014, Rating-based investment practices and bond market segmentation, working paper.

Cornaggia, J., and Cornaggia, K.J., 2013. Estimating the costs of issuer-paid credit ratings, *Review of Financial Studies* 26(10) 2229-2269.

Cornaggia, J., Cornaggia, K.J, and Hund, J., 2013. Credit ratings across asset classes, working paper.

Cornaggia, J., Cornaggia, K.J., and Xia, H., 2013. Revolving doors on Wall Street, working paper.

Dichev, I.D., and Piotroski, J.D., 2001. The long-run stock returns following bond ratings changes, *Journal of Finance* 41, 173–203.

Ederington, L.H., and Goh, J.C., 1998. Bond rating agencies and stock analysts: Who knows what when?, *Journal of Financial and Quantitative Analysis* 33(4), 569-585.

Ellul, A., Jotikasthira, C., and Lundblad, C., 2011. Regulatory pressure and fire sales in the corporate bond markets, *Journal of Financial Economics* 101(3), 596-620.

Faulkender, M., and Peterson, M.A., 2006. Does the source of capital affect capital structure? *Review of Financial Studies* 19(1), 45-79.

Goh, J.C, and Ederington, L.H., 1993. Is a bond rating downgrade good news, bad news or ne news to stockholders? *Journal of Finance* 48, 2001-2008.

Gore, A.K., Sachs, K., and Trzcinka, C., 2003. Financial disclosure and bond insurance, *Journal of Law and Economic*s 47(1), 275-306.

Green, R., Hollifield, B., and Schurhoff, N., 2007. Dealer intermediation and price behavior in the aftermarket for new bond issues, *Journal of Financial Economics* 86, 643-682.

Green, R., Li, D., and Schurhoff, N., 2010. Price discovery in illiquid markets: Do financial asset prices rise faster than they fall?, *Journal of Finance* 65, 1669-1702.

Griffin, J.M., and Tang, D., 2012. Did subjectivity play a role in CDO credit ratings? *Journal of Finance* 67(4), 1293-1328.

Griffin, J.M., J. Nickerson, and D.Y. Tang, 2013, Rating shopping or catering? An examination of the response to competitive pressure for CDO ratings, *Review of Financial Studies* 26 (9) 2270-2310.

Grossman, S.J., and Stiglitz, J.E., 1980. On the impossibility of informationally efficient markets, *American Economic Review* 70(3), 393-408.

Hand, J.R.M., Holthausen, R.W., and Leftwich, R.W., 1992. The effect of bond rating agency announcements on bond and stock prices, *Journal of Finance* 47(2), 733-52.

Hanley, K.W., and Nikolova, S., 2013. The removal of credit ratings from capital regulation: Implications for systemic risk, working paper.

Harris, L., Piwowar, M., 2006.Secondary trading costs in the municipal bond market, *Journal of Financial Economics* 61,1361–1397.

He, J., Qian, J., and Strahan, P.E., 2012. Are all ratings created equal? The impact of issuer size on the pricing of mortgage-backed securities, *Journal of Finance* 67(6) 2097-2137.

Hettenhouse, G.W., and Sartoris, W.L., 1976. An analysis of the information value of bondrating changes, *Quarterly Review of Economics and Business* 16, 65–78.

Hite, G., and Warga, A., 1997. The effect of bond-rating changes on bond price performance, *Financial Analysts Journa*l, May/June, 35-51.

Holthausen, R.W., and Leftwich, R.W., 1986. The effect of bond rating changes on common stock prices, *Journal of Financial Economics* 17, 57-89.

Hovakimian, A., Opler, T., and Titman, S. 2001, The debt-equity choice, *Journal of Financial and Quantitative Analysis* 36, 1–24.

Ingram, R.W., Brooks, L.E., and Copeland, R.M., 1983. The information content of municipal bond rating changes: A note, *Journal of Finance* 38(3), 997-1003.

Jiang, J.X., Stanford, M., and Yuan, X., 2012. Does it matter who pays for bond ratings? Historical evidence. *Journal of Financial Economics* 105(3), 607-621.

Kadan. O., Madureira, L., Wang, R., and Tzachi, Z., 2009. Conflicts of interest and stock recommendations: The effect of the global settlement and related regulations, *Review of Financial Studies*, 22, 4189-4217.

Kisgen, D.J., 2006. Credit ratings and capital structure, *Journal of Finance* 61(3), 1035-72.

Kisgen, D.J., 2009. Do firms target credit ratings or leverage levels?, *Journal of Financial and Quantitative Analysis*, 44(6), 1323-1344.

Kisgen, D.J., 2012, The real and financial effects of credit ratings: Evidence from Moody's adjustments, working paper.

Kisgen, D.J., and Strahan, P.E., 2010. Do regulations based on credit ratings affect a firm's cost of capital?, *Review of Financial Studies* 23(12), 4324-47.

Kliger, D., and Sarig, O., 1999. The information value of bond ratings, *Journal of Finance*, 55(6), 2879-2903.

Manso, G., 2013. Feedback effects of credit ratings, *Journal of Financial Economics*, forthcoming.

Mathis, J., McAndrews, J., and Rochet, J.C., 2009. Rating the raters: Are reputation concerns powerful enough to discipline rating agencies?, *Journal of Monetary Economics* 56, 657-674.

Moody's Investors Service, 2002, Moody's US Municipal Bond Rating Scale.

Moody's Investors Service, 2007, The U.S. Municipal Bond Rating Scale: Mapping to the Global Rating Scale and Assigning Global Scale Ratings to Municipal Obligations, March Rating Methodology.

Moody's Investors Service, 2009, Moody's Rating Symbols & Definitions, June.

Moody's Investors Service, 2010, Recalibration of Moody's U.S. Municipal Ratings to its Global Rating Scale, March U.S. Public Finance.

Opp, C, Opp, M., and Harris, M. 2013. Rating agencies in the face of regulation. *Journal of Financial Economics* 108, 46-61.

Partnoy, F., 1999. The Siskel and Ebert of financial markets: two thumbs down for the credit rating agencies, *Washington University Law Quarterly* 77, 619-712.

Pinches, G.E., and Singleton, J.C., 1978. The adjustment of stock prices to bond rating changes, *Journal of Finance* 33(1), 29-44.

Ramakrishnan, R.T., and Thakor, A.V., 1984. Information reliability and a theory of financial intermediation, *Review of Economic Studies* 51, 415-532.

Sangiorgi, F., Sokobin, J., and Spatt, C., 2009. Credit-rating shopping, selection and the equilibrium structure of ratings, working paper.

Schultz, P., 2012. The market for new issues of municipal bonds: The roles of transparency and limited access to retail investors, *Journal of Financial Economics* 106, 492-512.

Skreta, V., and Veldkamp, L., 2009. Ratings shopping and asset complexity: A theory of ratings inflation, *Journal of Monetary Economics* 56, 678-695.

Strobl, G., and Xia, H., 2012. The issuer-pays rating model and ratings inflation: Evidence from corporate credit ratings, working paper.

Sufi, A., 2009. The real effects of debt certification: Evidence from the introduction of bank loan ratings, *Review of Financial Studies* 22(4), 1659-91.

Tang, T.T., 2009. Information asymmetry and firms' credit market access: Evidence from Moody's credit rating format refinement, *Journal of Financial Economics* 93, 325-51.

U.S. Securities and Exchange Commission, 2011. Summary report of commission staff's examinations of each NRSRO as required by Section 15E(p)(3)(c) of the Securities Exchange Act of 1934.

Weinstein, M.I., 1977. The effect of a rating change announcement on bond price, *Journal of Financial Economics* 5, 329-350.

White, L.J., 2010. Markets: The credit rating agencies, *Journal of Economic Perspectives*, 24(2), 211-226.

Xia, H., 2013. Can investor-paid credit rating agencies improve the information quality of issuer-paid rating agencies?, working paper.

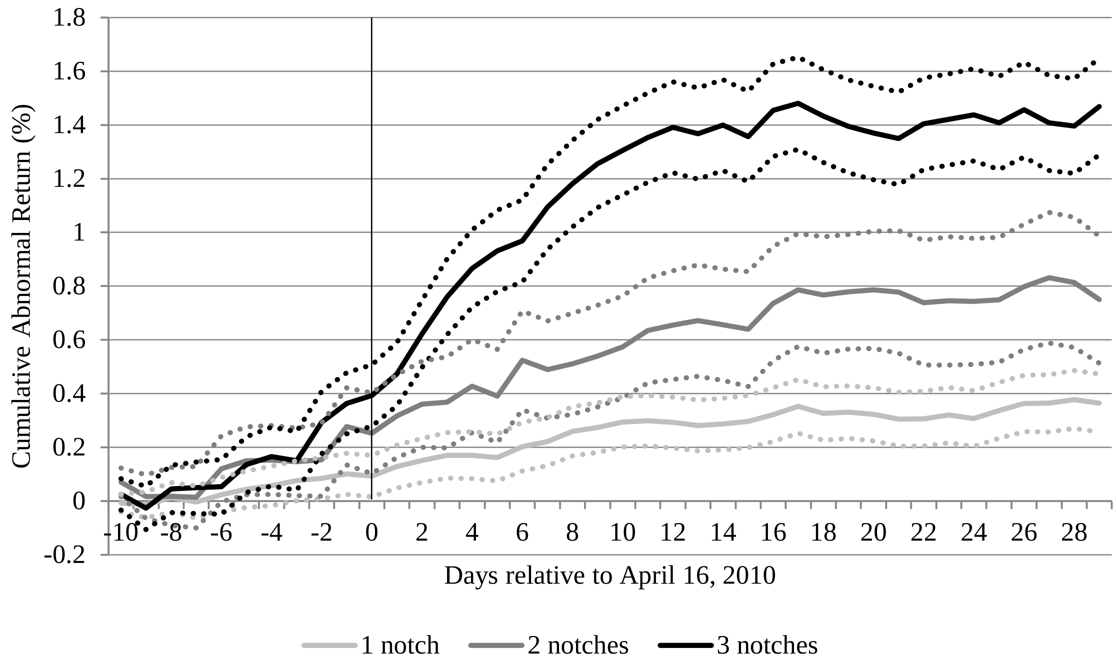

Figure 1. Cumulative abnormal returns around first recalibration date. This figure displays cumulative abnormal returns of outstanding municipal bonds that Moody's upgraded on April 16, 2010, the first of four recalibration dates. We split the bonds by the size of the upgrade (one, two, or three notches). The comparison group consists of municipal bonds that were recalibrated on April 16, 2010, but not upgraded. We gather secondary market trading data from the MSRB Electronic Municipal Market Access (EMMA) database.

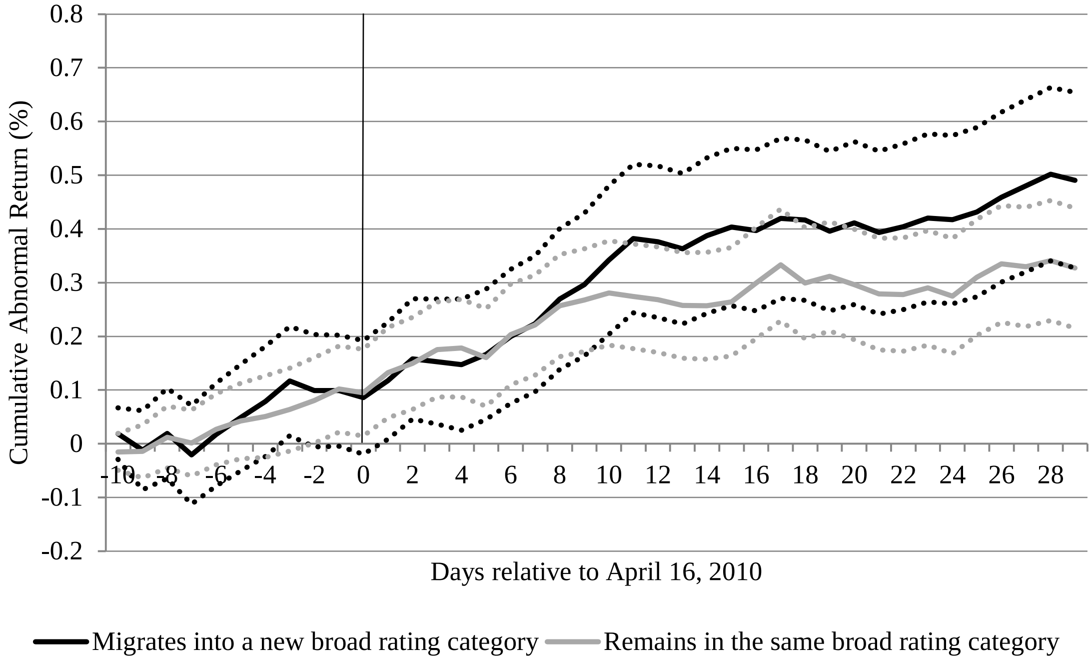

Figure 2. Cumulative abnormal returns around first recalibration date for municipal bonds with one-notch upgrades. This figure displays cumulative abnormal returns of outstanding municipal bonds that Moody's upgraded one notch on April 16, 2010, the first of four recalibration dates. We split the bonds by whether the upgraded rating migrated into a new broad rating category or remained within a broad rating category. For example, a one-notch upgrade from A1 to Aa3 would migrate into a new broad rating category, whereas a one-notch upgrade from A2 to A1 would remain within a broad rating category. The comparison group consists of municipal bonds that were recalibrated on April 16, 2010, but not upgraded. We gather secondary market trading data from the MSRB Electronic Municipal Market Access (EMMA) database.

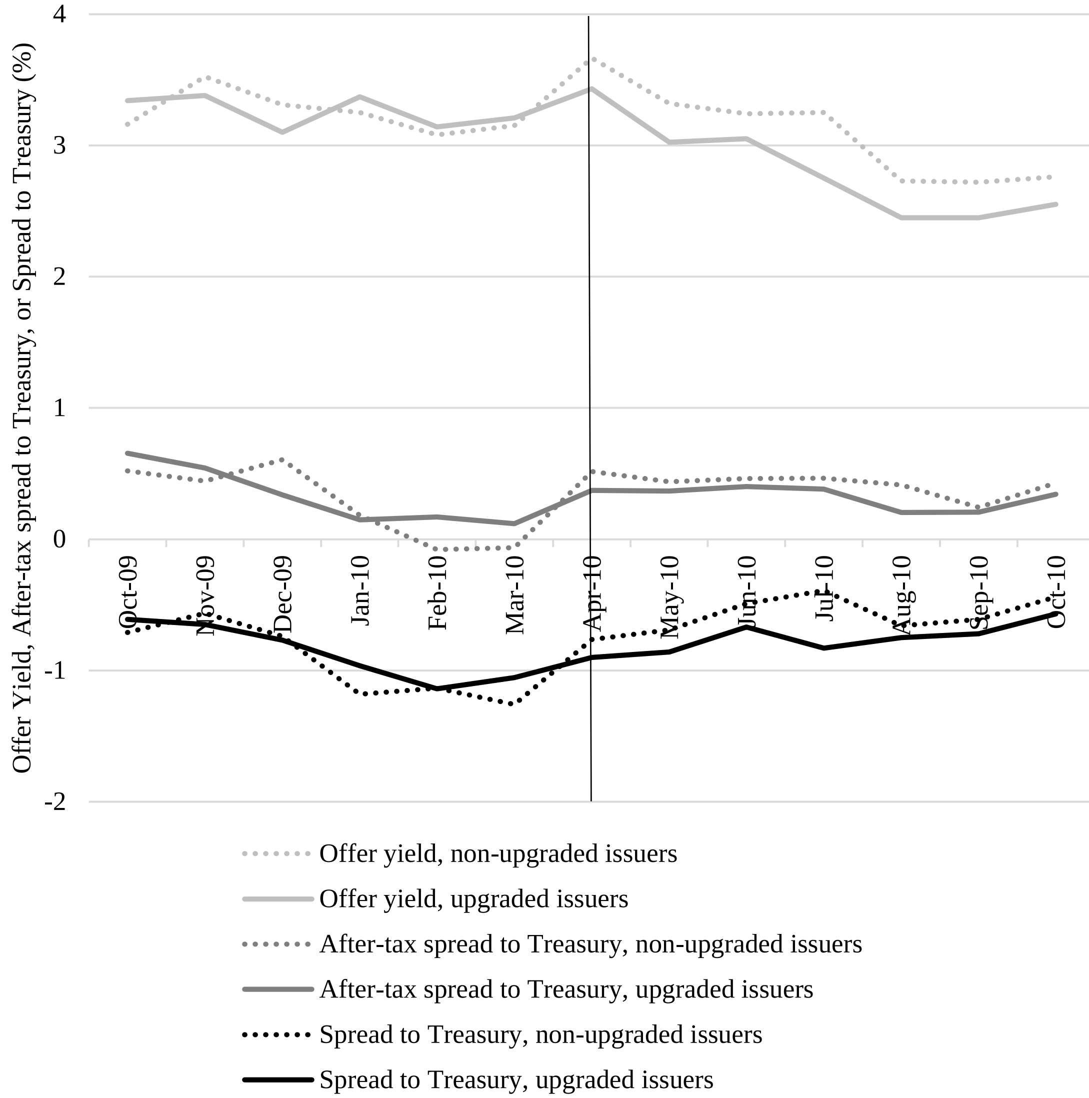

Figure 3. Offer yields and spreads on new issues around recalibration. This figure displays average offer yields and spreads on new municipal bond issues according to whether the issuers' bonds were upgraded during recalibration. We measure offer yields in three ways. First, we examine raw offer yields. Second, we compute the spread between a bond's raw offer yield and the yield of the U.S. Treasury bond with the closest maturity on the day of issuance. Third, we compute after-tax spread to treasury as the difference between a bond's raw offer yield and the after-tax yield of the U.S. Treasury bond with the closest maturity on the day of issuance. We assume a marginal tax rate of 35%. If the bond is a Build America Bond, we compute the after-tax spread to treasury as the difference between its after-tax offer yield (assuming a 35% marginal tax rate) and the after-tax yield of the U.S. Treasury bond with the closest maturity on the day of issuance. The vertical line denotes April 2010, the month with the first and most numerous recalibrations. Offer yield data come from the Ipreo i-Deal new issues database.

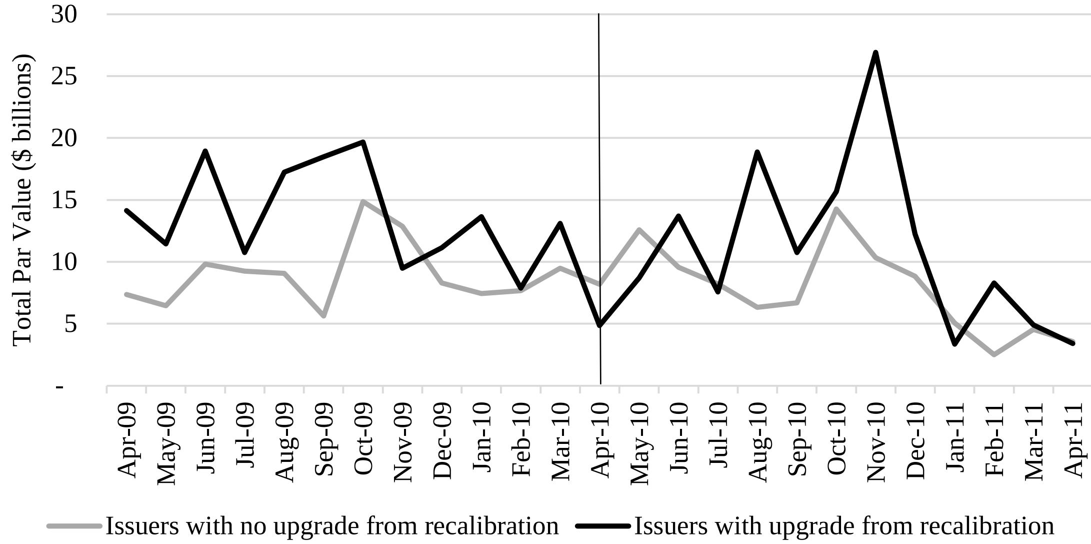

Figure 4. Dollar volume of issues per month by whether the issuers are upgraded. This figure displays the total par value of uninsured municipal bonds issued per month from April 2009 to April 2011. For use in multivariate tests, this sample includes only municipalities that issue at least one bond in the year prior and the year following the recalibration event. We split the sample by whether Moody's upgrades any of the issuers' outstanding bonds during a recalibration event. The vertical line denotes April 2010, the month with the first and most numerous recalibrations. The data come from the Ipreo i-Deal new issues database.

Table I
Distribution of Rating Changes for Subsample Used in CAR Calculations

This table displays distributions of bonds according to the magnitude of credit ratings changes during recalibration events. For admission to this table, we require bonds to have sufficient secondary market trading data to calculate cumulative abnormal returns. Bond characteristics come from the Ipreo i-Deal new issues database. We collect ratings data from Moody's.

	Magnitude of rating change			
Recalibration date	0 notches	1 notch	2 notches	3 notches
April 16, 2010	1,135	3,721	364	887
April 23, 2010	309	785	231	23
May 3, 2010	587	733	205	13
May 7, 2010	4,657	562	4	1

Table II

Regulation-Based Changes in Trading Volume around Recalibration Events

This table displays OLS regression results with the log of one plus the average daily trading volume as the dependent variable. We restrict the sample to bonds that experienced upgrades of one notch (Panel A) or two notches (Panel B) and we parse the data by the type of transaction: Inter-dealer trades, Customer purchases, or Customer sales. *New broad rating category* is a dummy variable taking a value of one if the upgraded bond migrated into a new broad rating category and zero if the upgraded bond remained within the same broad rating category. *Post recalibration* is a dummy variable taking a value of one for volume observations averaged over 20 days after a recalibration event and zero for volume observations averaged over 20 days before a recalibration event. We gather secondary market trading data from the MSRB Electronic Municipal Market Access (EMMA) database. We collect ratings data from Moody's. Standard errors are clustered at the CUSIP level and reported in parentheses below coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: One-notch Upgrades

	Type of transaction		
	Inter-dealer trades	Customer purchases	Customer sales
New broad rating category × Post recalibration	0.21	0.28	0.03
	(0.09)**	(0.11)***	(0.10)
New broad rating category	-0.10	-0.15	0.18
	(0.07)	(0.07)**	(0.07)***
Post recalibration	-0.41	-0.65	-0.21
	(0.05)***	(0.05)***	(0.05)***
Constant	3.57	5.57	4.40
	(0.03)***	(0.03)***	(0.03)***
Adjusted R^2	0.002	0.005	0.001
Observations	45,834	45,834	45,834

Panel B: Two-notch Upgrades

	Type of transaction		
	Inter-dealer trades	Customer purchases	Customer sales
New broad rating category × Post recalibration	0.45	0.98	-0.26
	(0.23)**	(0.28)***	(0.24)
New broad rating category	-0.16	-0.34	0.49
	(0.18)	(0.17)**	(0.16)***
Post recalibration	-0.66	-1.53	0.25
	(0.20)***	(0.25)***	(0.21)
Constant	3.47	5.68	3.15
	(0.16)***	(0.15)***	(0.14)***
Adjusted R^2	0.002	0.010	0.001
Observations	3,857	3,857	3,857

Table III

Summary Statistics for Observations in Multivariate Regressions

This table displays summary statistics for uninsured municipal bonds issued in the year before April 16, 2010 (the first recalibration date) and the year after May 7, 2010 (the fourth and final recalibration date). In order for a bond to be in the sample, we require its issuer to issue at least one new bond in both time periods. *Offer yield* is the raw offer yield on the bond. *Spread to Treasury* is the difference between a bond's offer yield on the date of issue and the yield of the U.S. Treasury bond with the closest maturity on the same day. *After-tax spread to Treasury* is the difference between a bond's offer yield on the date of issue and the after-tax yield of the U.S. Treasury bond with the closest maturity on the same day. We assume a tax rate of 35%. If the bond is a Build America Bond, *After-tax spread to Treasury* is the difference between its after-tax offer yield (assuming a 35% marginal tax rate) and the after-tax yield of the U.S. Treasury bond with the closest maturity on the day of issuance. *Rating at issue* is a numerical translation of Moody's 21-point alphanumeric scale. Ratings are increasing in credit quality, such that Aaa = 21, Aa1 = 20, ..., C = 1. *Par* is the bond's par value measured in millions of dollars. *Maturity* is the bond's maturity measured in years. *Coupon* is the bond's coupon expressed as a percentage. *Outstanding bonds* is the number of other bonds outstanding for the issuer at the time of issuance. *GO* is an indicator variable taking a value of one if the bond is a general obligation bond and zero if the bond is a revenue bond or other type. *BAB* is an indicator variable taking a value of one if the bond is a Build America Bond and zero if not. We calculate the average rating of all outstanding bonds for each issuer before (*Issuer rating pre-recalibration*) and after (*Issuer rating post-recalibration*) the recalibration dates. *Notches* represents the change in this number rounded to the nearest whole number. Panel A splits the full sample by whether Moody's upgraded the issuers' outstanding bonds during the recalibration events. Panel B splits the sample by whether the bonds were issued in the year before the recalibration events or after. Bond characteristics come from the Ipreo i-Deal new issues database. We collect ratings data from Moody's.

Panel A: Sample Split by Whether Issuers' Bonds Are Upgraded During Recalibration

	Offer yield	Spread to Treasury	After-tax spread to Treasury	Rating at issue	Par	Maturity	Coupon	Outstanding bonds	GO	BAB	Issuer rating pre-recal.	Issuer rating post-recal.	Notches
No change in issuers' ratings due to recalibration (N = 25,153)													
Mean	3.1087	-0.5576	0.4859	19.3	6.6	9.0	3.79	718	0.34	0.18	19.3	19.3	0.0
SD	1.4168	0.9476	0.9340	1.7	28.8	6.5	1.26	849	0.48	0.39	1.6	1.6	0.0
Min	0.0800	-4.6500	-2.9945	11	0.0	0	0.00	2	0	0	11	11	0
p25	2.0200	-1.2400	-0.1940	18	0.6	4	3.00	188	0	0	18	18	0
Median	3.2000	-0.6400	0.3870	20	1.6	8	4.00	464	0	0	20	20	0
p75	4.1300	0.0400	1.0825	21	4.8	13	5.00	821	1	0	21	21	0
Max	8.3700	4.6200	5.9325	21	1,850	42	8.37	5,739	1	1	21	21	0
Issuers' ratings upgraded due to recalibration (N = 38,755)													
Mean	3.0792	-0.5881	0.4404	18.5	6.0	8.8	3.75	606	0.60	0.19	17.9	19.2	1.3
SD	1.4412	0.9579	0.9206	1.5	34.5	6.2	1.24	943	0.49	0.39	1.4	1.1	0.5
Min	0.1000	-4.0900	-2.5360	11	0.0	0	0.00	1	0	0	12	13	1
p25	1.9700	-1.2800	-0.2295	18	0.4	4	3.00	152	0	0	17	19	1
Median	3.1000	-0.7200	0.3185	19	1.1	8	4.00	287	1	0	18	19	1
p75	4.0800	-0.0400	1.0030	19	3.4	12	5.00	626	1	0	19	20	1
Max	10.0000	6.6000	7.1140	21	2,110	48	10.00	6,109	1	1	20	21	4

Panel B: Sample Split by Period of Issuance

	Offer yield	Spread to Treasury	After-tax spread to Treasury	Rating at issue	Par	Maturity	Coupon	Outstanding bonds	GO	BAB
Issued in the year before recalibration (N = 33,362)										
Mean	3.2462	-0.6313	0.4550	18.5	6.6	9.1	3.89	647	0.50	0.19
SD	1.4141	0.9924	0.9608	1.7	33.3	6.4	1.21	885	0.50	0.39
Min	0.0800	-4.6500	-2.9945	11	0.0	0	0.00	6	0	0
p25	2.2000	-1.3600	-0.2410	18	0.5	4	3.00	170	0	0
Median	3.3000	-0.7500	0.3517	19	1.5	8	4.00	348	1	0
p75	4.2100	-0.0100	1.0565	20	4.3	13	5.00	717	1	0
Max	8.5000	6.6000	6.7400	21	1,750	48	8.50	6,030	1	1
Issued in the year after recalibration (N = 30,546)										
Mean	2.9211	-0.5157	0.4619	19.2	5.8	8.7	3.63	653	0.49	0.18
SD	1.4317	0.9063	0.8868	1.4	31.4	6.2	1.28	934	0.49	0.39
Min	0.2000	-4.0900	-2.5535	11	0.0	0	0.00	1	0	0
p25	1.7700	-1.1700	-0.1865	19	0.4	4	2.88	163	0	0
Median	2.9500	-0.6300	0.3365	19	1.1	8	3.95	348	1	0
p75	3.9600	0.0000	1.0120	20	3.5	12	4.88	705	1	0
Max	10.0000	5.5600	7.1140	21	2,110	42	10.00	6,109	1	1

Table IV

The Effect of Recalibrated Ratings on Offer Yields and Spreads

This table displays OLS regression results with various measures of offer yields as the dependent variable. Columns (1) through (3) use *Offer yield*, the raw offer yield on the bond. Columns (4) through (6) use *Spread to Treasury*, the difference between a bond's offer yield on the date of issue and the yield of the U.S. Treasury bond with the closest maturity on the same day. Columns (7) through (9) use *After-tax spread to Treasury* as the dependent variable. *After-tax spread to Treasury* is the difference between a bond's offer yield on the date of issue and the after-tax yield of the U.S. Treasury bond with the closest maturity on the same day. We assume a tax rate of 35%. If the bond is a Build America Bond, *After-tax spread to Treasury* is the difference between its after-tax offer yield (assuming a 35% marginal tax rate) and the after-tax yield of the U.S. Treasury bond with the closest maturity on the day of issuance. Panel A captures the effect of the recalibration on offer yields and spreads with *Upgrade*, a dummy variable taking a value of one if the issuer of the bond experienced an upgrade on its outstanding bonds during any of the recalibration events and zero if the issuer's bonds experienced no change in their ratings. *Post recalibration* is a dummy variable taking a value of one if the bond was issued in the year after the issuer's bonds were recalibrated by Moody's, and zero if the bond was issued in the year prior to the recalibration events. *Par* is the bond's par value measured in millions of dollars. We use the natural log of one plus this value in the regressions. *Maturity* is the bond's maturity measured in years. *Coupon* is the bond's coupon expressed as a percentage. *Outstanding bonds* is the number of other bonds outstanding for the issuer at the time of issuance. We use the natural log of one plus this value in the regressions. *GO* is an indicator variable taking a value of one if the bond is a general obligation bond and zero if the bond is a revenue bond or other type. *BAB* is an indicator variable taking a value of one if the bond is a Build America Bond and zero if not. *Issuer rating pre- (post-) recalibration* is the average rating of the bond's issuer's outstanding bonds before (after) the recalibration events rounded to the nearest whole number. This variable is a numerical translation of Moody's 21-point alphanumeric scale. Ratings are increasing in credit quality, such that Aaa = 21, Aa1 = 20, ..., C = 1. Panel B captures the effect of the recalibration on offer yields with *Notches*, the difference between *Issuer rating post-recalibration* and *Issuer rating pre-recalibration*, rounded to the nearest whole number. Bond characteristics come from the Ipreo i-Deal new issues database. We collect ratings data from Moody's. We cluster standard errors by issuer. Standard errors are in parentheses below coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Upgrade Dummy

	Offer yield			Spread to Treasury			After-tax spread to Treasury		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post recal. × Upgrade	-0.13	-0.13	-0.09	-0.17	-0.17	-0.16	-0.16	-0.16	-0.15
	(0.03)***	(0.03)***	(0.03)***	(0.04)***	(0.04)***	(0.04)***	(0.03)***	(0.03)***	(0.03)***
Post recalibration	-0.12	-0.11	-0.12	0.26	0.27	0.30	0.15	0.15	0.17
	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.02)***	(0.02)***	(0.02)***
Upgrade	-0.10	0.04		-0.12	0.05		-0.11	0.05	
	(0.03)***	(0.03)		(0.03)***	(0.03)*		(0.03)***	(0.03)*	
Par	-0.21	-0.21	-0.24	-0.02	-0.02	-0.01	-0.09	-0.09	-0.10
	(0.01)***	(0.02)***	(0.01)***	(0.01)*	(0.01)**	(0.01)	(0.01)***	(0.01)***	(0.01)***
Maturity	0.15	0.15	0.15	0.07	0.07	0.08	0.09	0.09	0.09
	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***
Coupon	0.35	0.35	0.37	0.05	0.05	0.05	0.12	0.12	0.12
	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***
Outstanding bonds	0.03	0.03	-0.18	0.01	0.00	-0.50	0.02	0.02	-0.35
	(0.01)***	(0.01)**	(0.09)**	(0.01)	(0.01)	(0.11)***	(0.01)**	(0.01)*	(0.09)***
GO	-0.18	-0.17	-0.21	-0.21	-0.19	-0.28	-0.21	-0.19	-0.26
	(0.03)***	(0.03)***	(0.05)***	(0.02)***	(0.02)***	(0.05)***	(0.02)***	(0.02)***	(0.04)***
BAB	0.46	0.46	0.55	0.57	0.57	0.63	-0.76	-0.76	-0.71
	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.02)***	(0.02)***	(0.03)***
Issuer rating pre-recal.	-0.12			-0.15			-0.13		
	(0.01)***			(0.01)***			(0.01)***		
Issuer rating post-recal.		-0.13			-0.16			-0.15	
		(0.01)***			(0.01)***			(0.01)***	
Constant	2.81	3.02	1.77	1.23	1.51	1.40	1.93	2.20	1.59
	(0.17)***	(0.18)***	(0.55)***	(0.17)***	(0.19)***	(0.65)**	(0.16)***	(0.17)***	(0.55)***
State of issuer FE?	Yes	Yes	N/A	Yes	Yes	N/A	Yes	Yes	N/A
Issuer FE?	No	No	Yes	No	No	Yes	No	No	Yes
Adjusted R^2	0.79	0.79	0.83	0.49	0.49	0.58	0.65	0.65	0.72
Observations	63,908	63,908	63,908	63,908	63,908	63,908	63,908	63,908	63,908

Panel B: Magnitude of Upgrade in Notches

	Offer yield			Spread to Treasury			After-tax spread to Treasury		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post recal. × Notches	-0.12	-0.12	-0.09	-0.14	-0.14	-0.13	-0.13	-0.13	-0.12
	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***
Post recalibration	-0.10	-0.10	-0.11	0.27	0.27	0.30	0.16	0.16	0.17
	(0.02)***	(0.02)***	(0.02)***	(0.03)***	(0.03)***	(0.03)***	(0.02)***	(0.02)***	(0.02)***
Notches	-0.05	0.08		-0.07	0.09		-0.07	0.08	
	(0.03)*	(0.02)***		(0.02)***	(0.02)***		(0.02)***	(0.02)***	
Par	-0.21	-0.21	-0.24	-0.02	-0.02	-0.01	-0.09	-0.09	-0.10
	(0.01)***	(0.01)***	(0.01)***	(0.01)*	(0.01)*	(0.01)	(0.01)***	(0.01)***	(0.01)***
Maturity	0.15	0.15	0.15	0.07	0.07	0.08	0.09	0.09	0.09
	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***
Coupon	0.35	0.35	0.37	0.05	0.05	0.05	0.12	0.12	0.12
	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***
Outstanding bonds	0.03	0.03	-0.19	0.00	0.00	-0.51	0.02	0.02	-0.36
	(0.01)**	(0.01)**	(0.09)**	(0.01)	(0.01)	(0.11)***	(0.01)*	(0.01)*	(0.09)***
GO	-0.18	-0.18	-0.20	-0.20	-0.20	-0.27	-0.20	-0.20	-0.25
	(0.03)***	(0.03)***	(0.05)***	(0.02)***	(0.02)***	(0.05)***	(0.02)***	(0.02)***	(0.04)***
BAB	0.46	0.46	0.55	0.56	0.56	0.63	-0.76	-0.76	-0.71
	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.02)***	(0.02)***	(0.03)***
Issuer rating pre-recal.	-0.13			-0.16			-0.15		
	(0.01)***			(0.01)***			(0.01)***		
Issuer rating post-recal.		-0.13			-0.16			-0.15	
		(0.01)***			(0.01)***			(0.01)***	
Constant	2.97	2.97	1.81	1.47	1.47	1.45	2.17	2.17	1.64
	(0.18)***	(0.18)***	(0.56)***	(0.19)***	(0.19)***	(0.66)**	(0.17)***	(0.17)***	(0.55)***
State of issuer FE?	Yes	Yes	N/A	Yes	Yes	N/A	Yes	Yes	N/A
Issuer FE?	No	No	Yes	No	No	Yes	No	No	Yes
Adjusted R^2	0.79	0.79	0.83	0.49	0.49	0.58	0.65	0.65	0.73
Observations	63,908	63,908	63,908	63,908	63,908	63,908	63,908	63,908	63,908

Table V

Multivariate Regressions Split by Pre- or Post-Recalibration Ratings

This table displays OLS regression results with *Spread to Treasury* as the dependent variable. *Spread to Treasury* is the difference between a bond's offer yield on the date of issue and the yield of the U.S. Treasury bond with the closest maturity on the same day. The first set of columns restrict the treatment and control samples to bonds issued by municipalities with average ratings prior to recalibration of Baa3, Baa2, or Baa1 (column (1)); A3, A2, or A1 (column (2)); and Aa3, Aa2, or Aa1 (column (3)). The second set of columns restrict the treatment and control samples to bonds issued by municipalities with average ratings after to recalibration of A3, A2, or A1 (column (4)); Aa3, Aa2, or Aa1 (column (5)); and Aaa (column (6)). Panel A captures the effect of the recalibration on offer yields with *Upgrade*, a dummy variable taking a value of one if the issuer of the bond experienced an upgrade on its outstanding bonds during any of the recalibration events and zero if the issuer's bonds experienced no change in their ratings. *Post recalibration* is a dummy variable taking a value of one if the bond was issued in the year after the issuer's bonds were recalibrated by Moody's, and zero if the bond was issued in the year prior to the recalibration events. *Par* is the bond's par value measured in millions of dollars. We use the natural log of one plus this value in the regressions. *Maturity* is the bond's maturity measured in years. *Coupon* is the bond's coupon expressed as a percentage. *Outstanding bonds* is the number of other bonds outstanding for the issuer at the time of issuance. We use the natural log of one plus this value in the regressions. *GO* is an indicator variable taking a value of one if the bond is a general obligation bond and zero if the bond is a revenue bond or other type. *BAB* is an indicator variable taking a value of one if the bond is a Build America Bond and zero if not. We calculate the average rating of the bond's issuer's outstanding bonds before and the recalibration events, rounding each to the nearest whole number. These variables are numerical translations of Moody's 21-point alphanumeric scale. Ratings are increasing in credit quality, such that Aaa = 21, Aa1 = 20, ..., C = 1. Panel B captures the effect of the recalibration on offer yields with *Notches*, the difference between the average rating of the bond's issuer's outstanding bonds before and the recalibration events. Bond characteristics come from the Ipreo i-Deal new issues database. We collect ratings data from Moody's. We cluster standard errors by issuer. Standard errors are in parentheses below coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Upgrade Dummy

	Ratings in the pre-recalibration period			Ratings in the post-recalibration period		
	Baa-range	A-range	Aa-range	A-range	Aa-range	Aaa
	(1)	(2)	(3)	(4)	(5)	(6)
Post recal. × Upgrade	0.69	-0.28	-0.11	-0.16	-0.13	-0.24
	(0.26)**	(0.11)**	(0.04)**	-0.14	(0.04)***	(0.06)***
Post recalibration	-0.30	0.28	0.26	0.28	0.25	0.28
	(0.25)	(0.10)***	(0.04)***	(0.10)***	(0.04)***	(0.05)***
Upgrade	0.03	0.03	-0.12	0.32	0.01	0.14
	(0.24)	(0.09)	(0.04)***	(0.09)***	(0.04)	(0.05)***
Par	-0.09	0.05	-0.05	0.04	-0.03	-0.08
	(0.08)	(0.02)**	(0.01)***	(0.02)*	(0.01)**	(0.02)***
Maturity	0.04	0.07	0.07	0.06	0.08	0.09
	(0.02)**	(0.01)***	(0.00)***	(0.01)***	(0.00)***	(0.00)***
Coupon	0.37	0.07	0.06	0.18	0.04	-0.01
	(0.12)***	(0.04)	(0.02)***	(0.06)***	(0.02)*	(0.02)
Outstanding bonds	-0.16	-0.04	0	-0.05	0.01	-0.03
	(0.14)	(0.02)**	(0.01)	(0.02)**	(0.02)	(0.02)
GO	-0.12	-0.31	-0.18	-0.2	-0.19	-0.2
	(0.27)	(0.06)***	(0.03)***	(0.07)***	(0.03)***	(0.04)***
BAB	0.53	0.44	0.62	0.25	0.62	0.66
	(0.39)	(0.06)***	(0.03)***	(0.12)**	(0.03)***	(0.06)***
Constant	-0.69	-1.02	-1.51	-1.31	-1.54	-1.43
	(0.91)	(0.17)***	(0.09)***	(0.25)***	(0.10)***	(0.14)***
State of issuer FE?	Yes	Yes	Yes	Yes	Yes	Yes
Issuer FE?	No	No	No	No	No	No
Adjusted R^2	0.53	0.47	0.41	0.50	0.46	0.47
Observations	956	15,034	39,572	6,196	44,322	12,641

Panel B: Magnitude of Upgrade in Notches

	Ratings in the pre-recalibration period			Ratings in the post-recalibration period		
	Baa-range	A-range	Aa-range	A-range	Aa-range	Aaa
	(1)	(2)	(3)	(4)	(5)	(6)
Post recal. × Notches	0.16	-0.15	-0.11	-0.09	-0.13	-0.18
	(0.10)	(0.05)***	(0.03)***	(0.06)	(0.03)***	(0.05)***
Post recalibration	-0.09	0.25	0.26	0.27	0.27	0.27
	(0.26)	(0.09)***	(0.03)***	(0.09)**	(0.03)***	(0.05)***
Notches	-0.29	0.01	-0.08	0.18	0.09	0.12
	(0.26)	(0.04)	(0.03)***	(0.04)***	(0.03)***	(0.04)***
Par	-0.08	0.05	-0.05	0.04	-0.03	-0.08
	(0.08)	(0.02)**	(0.01)***	(0.02)*	(0.01)**	(0.02)***
Maturity	0.04	0.08	0.07	0.06	0.08	0.09
	(0.02)*	(0.01)***	(0.00)***	(0.01)***	(0.00)***	(0.00)***
Coupon	0.38	0.07	0.06	0.18	0.04	-0.01
	(0.12)***	(0.04)	(0.02)***	(0.06)***	(0.02)*	(0.02)
Outstanding bonds	-0.11	-0.05	0.00	-0.06	0.01	-0.03
	(0.15)	(0.02)***	(0.01)	(0.02)***	(0.02)	(0.02)
GO	-0.10	-0.29	-0.18	-0.23	-0.21	-0.20
	(0.27)	(0.06)***	(0.03)***	(0.08)***	(0.03)***	(0.04)***
BAB	0.51	0.44	0.62	0.27	0.62	0.66
	(0.38)	(0.06)***	(0.03)***	(0.11)**	(0.03)***	(0.06)***
Constant	-0.54	-0.98	-1.55	-1.22	-1.62	-1.42
	(1.07)	(0.17)***	(0.09)***	(0.24)***	(0.09)***	(0.14)***
State of issuer FE?	Yes	Yes	Yes	Yes	Yes	Yes
Issuer FE?	No	No	No	No	No	No
Adjusted R^2	0.53	0.50	0.47	0.50	0.46	0.47
Observations	956	15,034	39,572	6,196	44,322	12,641

Table VI

The Effect of Recalibrated Ratings on Spreads: Information versus Regulation-Based Demand

This table displays OLS regression results with *Spread to Treasury* as the dependent variable. *Spread to Treasury* is the difference between a bond's offer yield on the date of issue and the yield of the U.S. Treasury bond with the closest maturity on the same day. The treatment sample in this table consists of bonds issued by municipalities who experienced upgrades of one notch on their outstanding bonds due to Moody's recalibration. The control sample consists of bonds issued by municipalities that experienced no change in the ratings of their outstanding bonds due to recalibration. Columns (1) through (3) restrict the treatment sample to bonds issued by municipalities whose upgraded ratings migrated into a new broad rating category. Columns (4) through (6) restrict the treatment sample to bonds issued by municipalities whose upgraded ratings remained within a broad rating category. *Upgrade* is a dummy variable taking a value of one if the issuer of the bond experienced an upgrade on its outstanding bonds during any of the recalibration events and zero if the issuer's bonds experienced no change in their ratings. *Post recalibration* is a dummy variable taking a value of one if the bond was issued in the year after the issuer's bonds were recalibrated by Moody's, and zero if the bond was issued in the year prior to the recalibration events. *Par* is the bond's par value measured in millions of dollars. We use the natural log of one plus this value in the regressions. *Maturity* is the bond's maturity measured in years. *Coupon* is the bond's coupon expressed as a percentage. *Outstanding bonds* is the number of other bonds outstanding for the issuer at the time of issuance. We use the natural log of one plus this value in the regressions. *GO* is an indicator variable taking a value of one if the bond is a general obligation bond and zero if the bond is a revenue bond or other type. *BAB* is an indicator variable taking a value of one if the bond is a Build America Bond and zero if not. *Issuer rating pre- (post-) recalibration* is the average rating of the bond's issuer's outstanding bonds before (after) the recalibration events rounded to the nearest whole number. This variable is a numerical translation of Moody's 21-point alphanumeric scale. Ratings are increasing in credit quality, such that Aaa = 21, Aa1 = 20, ..., C = 1. Bond characteristics come from the Ipreo i-Deal new issues database. We collect ratings data from Moody's. We cluster standard errors by issuer. Standard errors are in parentheses below coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Upgrades into new broad rating category			Upgrades within broad rating category		
	(1)	(2)	(3)	(4)	(5)	(6)
Post recal. × Upgrade	-0.22	-0.22	-0.21	-0.11	-0.11	-0.11
	(0.05)***	(0.05)***	(0.06)***	(0.04)***	(0.04)***	(0.04)***
Post recalibration	0.26	0.26	0.29	0.27	0.27	0.3
	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***
Upgrade	-0.01	0.14		-0.19	-0.03	
	(0.04)	(0.04)***		(0.04)***	(0.03)	
Par	-0.04	-0.04	-0.03	-0.04	-0.04	-0.02
	(0.02)***	(0.02)***	(0.02)*	(0.01)***	(0.01)***	(0.01)
Maturity	0.08	0.08	0.08	0.07	0.07	0.07
	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***
Coupon	0.04	0.04	0.05	0.07	0.07	0.08
	(0.03)	(0.03)	(0.03)**	(0.02)***	(0.02)***	(0.02)***
Outstanding bonds	-0.01	-0.01	-0.46	-0.01	-0.01	-0.44
	(0.01)	(0.01)	(0.13)***	(0.01)	(0.01)	(0.11)***
GO	-0.23	-0.23	-0.26	-0.17	-0.17	-0.25
	(0.03)***	(0.03)***	(0.05)***	(0.03)***	(0.03)***	(0.06)***
BAB	0.53	0.53	0.62	0.55	0.55	0.63
	(0.04)***	(0.04)***	(0.05)***	(0.03)***	(0.03)***	(0.04)***
Issuer rating pre-recal.	-0.16			-0.16		
	(0.01)***			(0.01)***		
Issuer rating post-recal.		-0.16			-0.16	
		(0.01)***			(0.01)***	
Constant	1.63	1.63	1.23	1.59	1.59	1.01
	(0.30)***	(0.30)***	(0.81)	(0.24)***	(0.24)***	(0.65)
State of issuer FE?	Yes	Yes	N/A	Yes	Yes	N/A
Issuer FE?	No	No	Yes	No	No	Yes
Adjusted R^2	0.50	0.50	0.58	0.49	0.49	0.57
Observations	32,112	32,112	32,112	46,858	46,858	46,858

Table VII

The Effect of Recalibrated Ratings in Different Information Environments

This table displays OLS regression results with *Spread to Treasury* as the dependent variable. *Spread to Treasury* is the difference between a bond's offer yield on the date of issue and the yield of the U.S. Treasury bond with the closest maturity on the same day. The control sample in each regression consists of bonds issued by municipalities that experienced no change in the ratings of their outstanding bonds due to recalibration. The treatment samples consist of bonds issued by municipalities that experienced upgrades ranging from zero to four notches due to Moody's recalibration. In columns (1) through (3), we split the treatment sample by the level of government issuing the bond. In columns (4) and (5), we split the treatment sample by whether the issuer is, or is located within, a state with below- or above-median corruption risk. We measure corruption risk with a state-level corruption risk index developed by the State Integrity Investigation. The corruption risk index is a snapshot from 2013. In columns (6) and (7), we split the treatment sample by whether the issuer is, or is located within, a state with below- or above-median opacity. We measure opacity with a state-level index developed by U.S. PIRG which ranks the 50 states by the extent to which they provide online access to government spending data. The opacity index is from 2010. In columns (8) and (9), we split the treatment sample by whether any of the issuer's bonds were rated by S&P in the year prior to Moody's recalibration. *Upgrade* is a dummy variable taking a value of one if the issuer of the bond experienced an upgrade on its outstanding bonds during any of the recalibration events and zero if the issuer's bonds experienced no change in their ratings. *Post recalibration* is a dummy variable taking a value of one if the bond was issued in the year after the issuer's bonds were recalibrated by Moody's, and zero if the bond was issued in the year prior to the recalibration events. *Par* is the bond's par value measured in millions of dollars. We use the natural log of one plus this value in the regressions. *Maturity* is the bond's maturity measured in years. *Coupon* is the bond's coupon expressed as a percentage. *Outstanding bonds* is the number of other bonds outstanding for the issuer at the time of issuance. We use the natural log of one plus this value in the regressions. *GO* is an indicator variable taking a value of one if the bond is a general obligation bond and zero if the bond is a revenue bond or other type. *BAB* is an indicator variable taking a value of one if the bond is a Build America Bond and zero if not. *Issuer rating pre-recalibration* is the average rating of the bond's issuer's outstanding bonds before the recalibration events rounded to the nearest whole number. This variable is a numerical translation of Moody's 21-point alphanumeric scale. Ratings are increasing in credit quality, such that Aaa = 21, Aa1 = 20, ..., C = 1. Bond characteristics come from the Ipreo i-Deal new issues database. We collect ratings data from Moody's. We cluster standard errors by issuer. Standard errors are in parentheses below coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Level of government			Corruption risk		Opacity		Also rated by S&P?	
	States	Counties	Cities	Low	High	Low	High	Yes	No
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post recal. × Upgrade	-0.05	-0.16	-0.27	-0.14	-0.19	-0.12	-0.22	-0.16	-0.20
	(0.05)	(0.06)***	(0.04)***	(0.06)**	(0.04)***	(0.05)***	(0.04)***	(0.04)***	(0.04)***
Post recalibration	0.27	0.26	0.27	0.28	0.24	0.26	0.27	0.27	0.26
	(0.03)***	(0.03)***	(0.03)***	(0.05)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***
Upgrade	-0.13	-0.09	-0.12	-0.14	-0.12	-0.15	-0.09	-0.16	-0.06
	(0.05)***	(0.07)	(0.04)***	(0.05)***	(0.04)***	(0.04)***	(0.04)**	(0.04)***	(0.04)
Par	-0.03	-0.05	-0.04	0.00	-0.04	-0.01	-0.04	-0.02	-0.04
	(0.02)**	(0.02)***	(0.02)***	(0.02)	(0.01)***	(0.02)	(0.01)***	(0.01)*	(0.01)***
Maturity	0.07	0.07	0.07	0.08	0.07	0.07	0.07	0.08	0.07
	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***
Coupon	0.05	0.06	0.09	0.04	0.07	0.04	0.08	0.05	0.08
	(0.02)**	(0.03)**	(0.02)***	(0.03)	(0.02)***	(0.02)*	(0.02)***	(0.02)**	(0.02)***
Outstanding bonds	-0.02	-0.02	-0.01	0.02	-0.01	0.00	-0.01	0.01	0.00
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GO	-0.17	-0.19	-0.21	-0.22	-0.19	-0.21	-0.18	-0.19	-0.26
	(0.03)***	(0.03)***	(0.03)***	(0.04)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.03)***
BAB	0.51	0.57	0.54	0.53	0.60	0.55	0.54	0.54	0.57
	(0.04)***	(0.05)***	(0.04)***	(0.05)***	(0.03)***	(0.04)***	(0.04)***	(0.03)***	(0.04)***
Issuer rating pre-recal.	-0.18	-0.16	-0.15	-0.15	-0.13	-0.17	-0.15	-0.16	-0.13
	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***
Constant	2.07	1.58	1.37	1.30	1.10	1.72	1.29	1.45	1.03
	(0.24)***	(0.29)***	(0.22)***	(0.25)***	(0.22)***	(0.22)***	(0.20)***	(0.21)***	(0.21)***
State of issuer FE?	No	No	No	No	No	No	No	Yes	Yes
Issuer FE?	No	No	No	No	No	No	No	No	No
Adjusted R^2	0.48	0.47	0.46	0.49	0.5	0.47	0.47	0.5	0.48
Observations	35,343	31,269	40,236	30,350	33,063	44,101	44,960	48,665	39,674

Table VIII

Did Standard & Poor's Respond to Moody's Recalibration?

This table displays ratings migration matrices for Standard & Poor's credit ratings around the time Moody's recalibrated its municipal bond ratings. We examine uninsured municipal bonds that were outstanding from April 16, 2010 to April 16, 2011. Panel A shows how the bonds' ratings transition for all bonds rated by S&P, irrespective of whether Moody's also rated the bonds. Panels B and C display the same for subsamples of Panel A, according to whether Moody's recalibrated (i.e., upgraded zero to four notches) the bonds' ratings. The horizontal axis represents the bonds' ratings from Standard & Poor's before the first recalibration date (April 16, 2010) and the vertical axis represents the bonds' outstanding ratings at the earlier of April 16, 2011 or when S&P assigned a new rating. We collect ratings data on bonds issued by state or local governments from Moody's and Standard & Poor's.

Panel A: All Municipal Bonds Rated by S&P

		Rating before scale change										
		AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	Sum
	AAA	38,984	705	83	21	1		3				39,797
	AA+	2,435	25,155	2,590	613	946	461	133		1	15	32,349
	AA	96	589	32,112	861	145	41					33,844
Rating	AA-	36	42	753	22,783	836	250	43				24,743
after	A+	62	31	17	916	13,745	943	68	3	9		15,794
scale	A	19	59	23	38	193	10,298	218	96	88		11,032
change	A-	45			29	2	671	5,126	177	94	3	6,147
	BBB+					33	135	39	2,224	199	10	2,640
	BBB	3	1			3	1,376	1	84	1,313	143	2,924
	BBB-								46	16	1,046	1,108
	Sum	41,680	26,582	35,578	25,261	15,904	14,175	5,631	2,630	1,720	1,217	170,378
	% Upgraded	0.0	2.7	7.5	5.9	12.1	12.0	8.3	10.5	22.7	14.1	
	% Downgraded	6.5	2.7	2.2	3.9	1.5	15.4	0.7	4.9	0.9	0.0	

Panel B: Moody’s Recalibrated

		Rating before scale change										
		AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	Sum
	AAA	29,756	496	2	1	1						30,256
	AA+	292	16,479	1,777	28	27	13	14				18,630
	AA	71	440	18,638	509	78						19,736
Rating	AA-	1	15	202	8,558	196	6					8,978
after	A+				576	3,963	101	7				4,647
scale	A	1	21		36	67	2,402	58	2	15		2,602
change	A-						47	1,583	32			1,662
	BBB+					33	29	29	952	55	7	1,105
	BBB						46		34	245	52	377
	BBB-										129	129
	Sum	30,121	17,451	20,619	9,708	4,365	2,644	1,691	1,020	315	188	88,122
% Upgraded		0.0	2.8	8.6	5.5	6.9	4.5	4.7	3.3	22.2	31.4	
% Downgraded		1.2	2.7	1.0	6.3	2.3	4.6	1.7	3.3	0.0	0.0	

Panel C: Moody's Did Not Recalibrate

		Rating before scale change										
		AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	Sum
	AAA	9,228	209	81	20			3				9,541
	AA+	2,143	8,676	813	585	919	448	119		1	15	13,719
	AA	25	149	13,474	352	67	41					14,108
Rating	AA-	35	27	551	14,225	640	244	43				15,765
after	A+	62	31	17	340	9,782	842	61	3	9		11,147
scale	A	18	38	23	2	126	7,896	160	94	73		8,430
change	A-	45			29	2	624	3,543	145	94	3	4,485
	BBB+						106	10	1,272	144	3	1,535
	BBB	3	1			3	1,330	1	50	1,068	91	2,547
	BBB-								46	16	917	979
	Sum	11,559	9,131	14,959	15,553	11,539	11,531	3,940	1,610	1,405	1,029	82,256
	% Upgraded	0.0	2.3	6.0	6.2	14.1	13.7	9.8	15.0	22.8	10.9	
	% Downgraded	20.2	2.7	4.0	2.4	1.1	17.9	0.3	6.0	1.1	0.0	