Rising Investor Sophistication and Declining Profitability in Municipal Bond Underwriting

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Abstract

We investigate the drivers of municipal underwriting profitability in light of recent exits of major underwriters. Using a structural model with latent investor type and comprehensive data on new issue markups and underwriting spreads over the 2005–2023 period, we find that the probability of encountering uninformed investors has reduced by half and the markups charged to these dwindling investors have fallen by a third. Meanwhile, underwriting spreads have not increased to offset declining markups. Given the increasing sophistication of investors, we show that the $100,000 trade size cutoff to classify retail versus institutional trades might no longer be appropriate.

Keywords: Public Finance; Municipal Bonds; Underwriters; Markup; Transparency

JEL Codes: G14, G23, G24

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1 Introduction

The $3.8 trillion municipal bond market provides a principal source of capital for funding public infrastructure and services across the United States. Municipal underwriters help local governments access this critical source of financing by organizing bond issuance, buying securities from issuers, and reselling them to investors. In late 2023, several prominent underwriters (including UBS and Citigroup, the largest municipal underwriter) exited the municipal underwriting business, raising concerns about the potential adverse impact on municipalities' access to finance and the associated costs. It has been suggested that these exits are linked to the rising anti-ESG sentiment by some state legislatures and governments, most notably illustrated by bans on various underwriters beginning in 2021 in Texas.[1] However, being banned from accessing one market—albeit a large one (Texas)—hardly seems a reasonable justification for exiting the underwriting business altogether, especially when these underwriters are present in almost all states across the U.S.[2] We propose an alternative explanation for underwriter exit based on changes in market microstructure: profits for dealers have dramatically declined over time, especially for the largest underwriters.

Using comprehensive data spanning 2005 to 2023, we provide an in-depth study of municipal underwriters' profitability over time, thus opening a window into the strategic decisions underwriters make and their implications for municipalities and investors. We document evidence of increased institutionalization and transparency, which we link via the model in

[1] https://www.bloomberg.com/news/articles/2023-10-10/ubs-to-exit-key-muni-investment-banking-business-plans-job-cuts?sref=ftig08a6

[2] Indeed, a recent article by S&P Global notes that "In 2023, a fervent anti-environmental, social and governance campaign swept state legislatures but failed to curtail the movement's main foe: Wall Street and its multitrillion-dollar asset management firms."

Green (2007) to a large decline in primary market markups, especially for the largest underwriters such as Citibank and UBS. Over time, we document that the percentage of profit from these markups for underwriters has fallen by nearly 50% from 2005 to 2023.

The evolution of markups and underwriting spreads over time is critical because the municipal bond market has changed markedly over the past two decades (see Cestau et al., 2019 for a thorough review of key trends in this market). First, with important policy efforts (such as the reporting and public dissemination of offering documents and secondary market trades by the MSRB and the implementation of markup disclosure rules by the SEC and FINRA), market transparency has significantly improved, with more information available to investors.[3] Second, institutional investors, including bond mutual funds, ETFs, and separately managed accounts, have increased their participation in this market.

More specifically, Green (2007)'s model allows us to study how dealer-underwriters, operating as Bertrand competitors for new securities, navigate a secondary market characterized by limited price transparency. The resultant price dispersion, particularly detrimental to retail customers lacking in information gathering capabilities, delineates a market where institutional investors secure more favorable terms due to their repeat interactions and informational advantages. Increased transparency and institutionalization of the investor base reduces the fraction of uninformed (hence profitable) investors and diminishes the secondary market rents that dealer-underwriters can extract from such investors without proportionately benefiting issuers due to the unchanged competitive dynamics in the primary market. Thus, underwriters should find their profits being increasingly compressed. Remarkably, the

[3]These patterns are consistent with what has been observed in the corporate bond market in response to increased transparency (Edwards et al., 2007).

empirical evidence we document in this paper using data up to the end of 2023 fully supports this prediction and confirms Green (2007)'s insights from nearly twenty years ago.

We build a comprehensive database from multiple sources on issuance details, trades, and underwriting spreads for all municipal bonds issued since 2005, including the Mergent Municipal Fixed Income Securities database ("Mergent"), the MSRB trade data, the SDC Platinum database, and Bloomberg. From these data, we document several trends in the municipal bond market. First, national underwriters (defined as those doing business in 40 or more states in any given year), although a minority in number, account for the bulk of underwriting activity in both the quantity and value of deals. Second, national underwriters tend to charge lower underwriting spreads to issuers and lower markups to investors in the new issue market. Even after controlling for a wide array of bond characteristics, these markups have been declining over time, particularly among national underwriters.

Next, we investigate the channels behind the declining profitability of national underwriters. Green (2007)'s model suggests that a decreasing mass of uninformed investors and/or their increasing informedness are drivers of shrinking underwriting profits. We formally estimate the fraction of uninformed investors and the markups they pay using a structural model inspired by the work of Green et al. (2007). The model links observed markups in the new issue market to bond and trade characteristics, but such links differ between informed and uninformed investor types. The investor type is latent, but we follow Green et al. (2007) by modeling investor type as a function of bond, issue, and trade characteristics (including underwriting spreads), signifying that investors take into account the nature of information asymmetry around the time of trade and the underwriter's markup-versus-markdown trade-off in choosing whether to become informed. Thus, the empirical model we estimate is a

mixture of regression models, consisting of an outcome equation for markups and a latent two-regime classification equation.

Our estimates indicate that over the sample period, the likelihood of encountering an uninformed investor decreases steadily from over 55% in 2006–2007 to 25% in 2022–2023. Moreover, markups charged to such investors have also fallen dramatically, from a high of 152 basis points (bps) in 2008–2009 to about 96 bps by the end of the sample period. Thus, over the last two decades or so, underwriters are half as likely to encounter uninformed investors when selling an issue. The markups they can charge these dwindling uninformed investors have also fallen by a third. To demonstrate the economic significance of our results, we estimate the profit underwriters earn from trading with uninformed investors ("money left on the table", or MLOT) per transaction, per bond, and per issue. All these profit measures have collectively declined by 30–50% over the sample period.

These new empirical regularities are especially informative for interpreting recent concerns about the exit of national underwriters as a result of state policy (Garrett and Ivanov, 2022). While policy choices are important and demand scrutiny, our results suggest that we have largely witnessed underwriter exits in response to a secular decline in profitability for underwriters for reasons unrelated to state policy. Our interpretation of their exits is consistent with their explanations. For instance, a Citigroup memo in December 2023 by Andy Morton, head of markets, and Peter Babej, interim head of banking, commented that "the economics of these activities are no longer viable given our commitment to increase the firm's overall returns."[4] This is not the first time that major underwriters have exited. For

[4] https://www.reuters.com/business/finance/citigroup-closes-municipal-underwriting-market-making-unit-memo-2023-12-14/

instance, UBS exited following the financial crisis, citing similar reasons related to risk and profitability.[5] In this sense, the recent exits from the municipal bond market appear to be driven less by state policies, like SB 13 and 19 in Texas, and more due to structural declines in the profitability of underwriting municipal debts.

Finally, we utilize our structural estimates to evaluate the appropriateness of the $100,000 trade size cutoff commonly used to delineate retail from institutional investors in the context of differentiating their level of informedness. This trade-size based classification has been used in prior work (notable papers include Hong and Warga, 2004; Harris and Piwowar, 2006; Green et al., 2006; Schultz, 2012; Cuny, 2017; and Hendershott et al., 2020) as well as in official rules (e.g., SEC rule 15-c2-12 as studied in Ivanov et al., 2024). We show that the correlation between trade size and the probability of informed trades is weak and diminishing over time. Moreover, the rate of correctly classifying trades below $100,000 as uninformed deteriorates over the sample period, falling below 50% since 2018. The performance is better for trades above $100,000, but the percentage of incorrectly classified trades in this category is still not trivial, averaging about 23% over the sample period. Looking more closely at trades below $100,000, we find that the distributions of informed and uninformed trades are very similar and growing more so over time. Furthermore, at round trade sizes ($25,000, $50,000, and $75,000) below the threshold, the two distributions are not distinguishable. If the goal is to proxy for informed versus uninformed trades, we thus caution against the future use of the $100,000 trade size cutoff.

Our paper contributes to a large literature on market transparency and transaction costs

[5] https://www.nytimes.com/2008/06/06/business/worldbusiness/06iht-ubs.1.13516985.html

in the municipal bond market.[6] Ever since Green et al. (2007) and Schultz (2012) (if not earlier), there has been a recognition that the municipal bond market is a decentralized broker-dealer market where pricing information can be costly to obtain and there exists a continuum of small investors. It is widely documented that the costs of trading are high and vary across investors, even for trading the same bond on the same day (see e.g., Harris and Piwowar, 2006, Green et al., 2006; Green et al., 2007). However, there is mixed evidence on whether markups have significantly declined over time. Several recent studies documented that transaction costs have declined, including Schultz (2012), Chalmers et al. (2021), Wu (2018), and Griffin et al. (2023). On the other hand, both Schultz (2012) and Griffin et al. (2023) find that, despite regulatory efforts to improve market transparency, markups in the new issue market do not decline as much as those on seasoned bonds, even more recently. Price dispersion and variation in markups linked to dealer market power still persist, as illustrated in Griffin et al. (2023) and Jotikasthira et al. (2023).

We contribute to this literature by showing that markups charged in the new issue market have declined significantly over time due to both a decrease in the probability of uninformed (hence profitable) trades and a decrease in markups dealers can charge on these dwindling uninformed trades. We further show that a shock to market transparency (the implementation of the markup disclosure rule in May 2018) significantly reduces search costs for investors, offering a possible explanation for our documented increase in investor sophistication.

Our paper also relates to the literature on underwriters and frictions in the underwriting process. Luby and Moldogaziev (2013) find that underwriting fees are positively correlated with risk and volatility in the muni market and that using local financial advisors helps re-

[6]See Bergstresser (2022) and Cestau et al. (2019) for a detailed review of the recent literature.

duce such fees, which they link to reduced information asymmetry. Garrett (2024) examines the conflicts of interest associated with dual underwriter-advisor arrangements and shows that such arrangements adversely affect municipal borrowing costs. Green et al. (2007) find that underwriting fees charged to issuers and markups charged to investors are substitutes. We contribute to this literature by showing that underwriters are increasingly squeezed on both sides: declining markups charged to investors while underwriting spreads under competitive pressures do not exhibit commensurate increases. Our results are also consistent with Garrett et al. (2023), who show how tax policy affects the market microstructure of the municipal bond market. In particular, they show that underwriters are unable to extract as much information rents through markups as the tax advantage increases, suggesting that differences in state-level policy contribute to increased competition. These results are related to our finding that markups have declined, at least in part due to the rise of larger underwriters that operate across states and growing transparency in the market.

Our findings also speak to the literature that documents the strong clientele effects in the municipal bond markets. Babina et al. (2021) and Bergstresser and Cohen (2015) show that the tax advantage of municipal bonds contributes to the segmentation of the market across state lines and the concentration of retail investors. Cornaggia et al. (2022) show evidence of inattentive muni investors, which highlights how the retail-dominated clientele of the muni market contributes to the lower level of market efficiency and helps explain the significant dispersion of markups documented in other studies. We contribute to this area of literature by providing estimates of the probability of uninformed trades. More importantly, we show that this probability has declined over time, suggesting a shift in the sophistication of investors in this market. Furthermore, our estimates facilitate an evaluation of the ap-

propriateness of the $100,000 trade size cutoff commonly used to distinguish between retail and institutional trades. Our analysis cautions against the use of such cutoff in separating investor type for studying differential levels of sophistication or information possessed.

The paper proceeds as follows. Section 2 lays out the key features of Green (2007)'s model to form the conceptual framework that guides our empirical analysis. Section 3 describes the data and presents key descriptive patterns. Section 4 analyzes the decline in markups and underwriting spreads in a multivariate regression framework. Section 5 presents the structural model to formally measure investor sophistication and estimate the extent of money left on the table. Section 6 assesses the use of the $100,000 trade size cutoff in classifying informed and uninformed trades and discusses the implications of such classification in future research. Section 7 concludes.

2 A Model of Underwriting Profit

To study the profit function of municipal underwriters, we rely on insights from Green (2007), a theoretical model of strategic interaction among issuers, underwriters, and investors. The model considers two intermediaries, each functioning as both underwriter and dealer ("underwriter–dealer"), who compete to underwrite the bond sale from the issuer and then sell securities to retail and institutional investors.

Underwriters first compete in a Bertrand manner (i.e., price) for the business of an issuer. After acquiring the securities, they can sell their inventory in a secondary market, where they are free to set prices and discriminate between retail and institutional investors. Retail investors are characterized by relatively high valuation and search costs, while institutional

investors have infinitely elastic demand at a lower price. Underwriter-dealers prioritize selling to the most profitable retail trades first, with any remaining inventory sold to institutional investors. Each underwriter-dealer has a limited capacity to reach retail investors, which is determined by their retail distribution network. The capacity constraint means that if the acquired inventory exceeds the underwriter retail capacity, the rest of the inventory must be sold to institutional investors at the lower institutional price. This constraint discourages the underwriters from bidding too aggressively on price for the underwriting business.

Green (2007) analyzes how dealers maximize their profits given the constraints of their retail capacity and the competitive pricing environment and identifies a range of Nash equilibria. They range from the most profitable equilibrium, where both dealers offer the issuer the institutional price and fully utilize their retail capacity, to a unique zero-profit equilibrium, where the dealers bid the same price above the institutional price and each receives exactly half of the issuance. Green (2007) argues that the most profitable equilibrium is particularly natural for the muni market setting and consistent with empirical outcomes documented in Green et al. (2007). In such an equilibrium, dealer i's expected profit is:

$$\pi(b_i, Q_i) = (\bar{p} - v)q\mu + (v - b_i)Q_i, \tag{1}$$

where b_i and Q_i are the bid price the dealer offers to the issuer and the allocated quantity of issuance, respectively, μ is the mass of retail customers, q is the probability that a retail customer chooses not to pay the search costs and remain uninformed, $\bar{p}$ is the reservation price above which no retail investor will buy the security, and v is the institutional price.

Empirically, Green et al. (2007) document that the price offered by underwriters to

issuers, plus the negotiated underwriting spread, is highly correlated with the institutional price. This implies that the empirical equivalence of $(v - b_i)$ is the underwriting spread, and that $(\bar{p} - v)$ represents the markup per bond in the new issue market. Thus, the dealer's expected profit expressed in Equation (1) has a natural interpretation: it is the combined markups charged to uninformed customers plus the spread earned on the amount underwritten. This equilibrium profit function allows us to make predictions with respect to underwriting profitability amid key changes in the municipal bond market.

The first change is a marked increase in market transparency over time. The SEC and MSRB have introduced various rules designed to improve market transparency, including mandates for post-trade price dissemination and markup disclosures (see Wu, 2018 for a history of MSRB market transparency enhancement activities since 2005 and Cestau et al., 2019 for a review of key trends in the muni market). A large literature, including Harris and Piwowar (2006) and Chalmers et al. (2021), among others, provides supportive evidence that increased market transparency results in lower transaction costs for investors. Thus, the probability that a retail investor remains uninformed (q) should decrease, thereby reducing underwriters' profits. Moreover, with greater availability of pricing information, the markup that dealers can charge uninformed retail customers $(\bar{p} - v)$ should shrink as well.

Second, there has been a clear increase in the participation of institutional investors in the muni market. For example, Cumberland Advisors document a steady rise of separately-managed accounts (SMAs) alongside the growth of muni mutual funds, concurrent with the decline in direct muni retail assets.[7] It appears that many retail investors have switched to

[7]Healy, Patricia, "The Rise of Separately Managed Accounts – 2021 Update," November 2, 2021, available at https://www.cumber.com/market-commentary/rise-separately-managed-accounts-2021-update

using SMAs to manage their muni investments and enjoy lower costs associated with institutional trading done by the SMAs. If retail participation decreases, a lower μ immediately implies decreased profits for muni underwriters.

The above insights from the Green et al. (2007) model provide conceptual guidance for our empirical work. Specifically, we examine how both the probability of uninformed trading and the markups on these uninformed trades decline over time with the rise of market transparency and participation of institutional investors. The resultant decrease in profitability, in turn, pushes some underwriters to exit the market. This empirical outcome, if supported using more comprehensive data and in more general settings, would corroborate Green (2007)'s prediction that issuers have no incentive to improve market transparency.

3 Data and Descriptive Statistics

3.1 Data

The data used in this analysis come from several sources. First, municipal bond issuance information is from the Mergent Municipal Fixed Income Securities database ("Mergent"). The data provide information on the total issue size, the offering date, the name of the issuer, the type of the offering (competitive versus negotiated), and the agents involved in the sale of the issue. Each bond issuance typically comprises multiple CUSIPs ("bonds") at various maturities. For each bond, the data include bond characteristics such as the issuance amount, coupon rate, maturity, bond type (GO versus revenue), use of funds, tax status, callability, credit rating, and whether it is insured.

Among the agents facilitating an issue sale, we focus on underwriters. We manually clean the names to ensure that multiple variations of an underwriter's name are attributed to the same underwriter. We then classify underwriters based on the geographic reach of their underwriting business, proxied by the number of states in which each given underwriter does business in a given year. "Single-state" underwriters are those that underwrite bonds in only one state in a given year. "Small regional" are those doing business in two to 19 states, "Large regional" if between 20 and 39 states, and "National" if 40 states and above.

The second data source is the trade data from the Municipal Securities Rule Making Board ("MSRB"). For each trade in a given bond, the MSRB data contain the timestamp, trade size, the trade type (for customer buy, customer sell, or interdealer trade), and the trade price, among others. Because we are interested in the markups that underwriters and their dealers charge customers when they distribute the bonds, we examine customer buy trades within 14 days of the offering date—similar to Schultz (2012) and Griffin et al. (2023), or until they fully absorb a bond size, whichever is earlier. This ensures that we examine trades in the new issue market and that the markup measure is not contaminated by secondary market activity. Following the literature, we compute the new issue markup as the difference between the customer purchase price and the offering price of the bond, expressed as a percentage of the offering price. For example, a markup of 0.2 indicates a 20 basis point (bp) markup over the offering price. For analysis at the bond level, we use the trade-size-weighted average markup across all new issue trades in each given bond.

Third, in addition to new issue markups, we collect underwriting spreads from the SDC Platinum database ("SDC"), combined with data from Bloomberg for those issuers without SDC spread data. The SDC data contain the reported gross spreads per $1000, which

we convert to percent of the issue size to be consistent with the Bloomberg spreads data. Underwriting spreads are at the issue level. To our knowledge, this is the most comprehensive underwriting spreads data used in a study of municipal underwriters' profits.

We provide details on our data cleaning procedures and filters in Table 1. Our sample period is from 2005 to 2023, dictated by the availability of the MSRB trade data. Our final sample consists of 183,502 issues and 2,076,767 bonds. Markup analyses are based on 12,389,917 new issue trades in these bonds. Analyses of underwriting spreads are based on 132,588 issues with available spreads data.

3.2 Descriptive Statistics

Table 2 provides summary statistics of municipal underwriting activity, markups, and spreads, categorized by underwriter type, over the sample period from 2005 to 2023. Panel A of Table 2 presents the average annual underwriting activity statistics, highlighting the vastly different scale of operation across underwriter types. The average single-state underwriter participates in approximately seven deals worth $66 million per year. Small regional underwriters—covering roughly seven states on average—are more active, with the average underwriter doing about 53 deals with a total volume of $615 million per year. Large regional underwriters typically cover about 28 states and are disproportionately more active than small regional ones, each taking part in about 255 deals totaling $5.5 billion in volume. Nevertheless, this activity level is about a third of that of an average national underwriter, which typically underwrites 655 bond sales worth $18.5 billion in about 44 states in a given year.[8]

[8]Figures A.1, **?**, and A.3 document the composition of underwriters by state in terms of the number of underwriters, quantity of deals, and volume, respectively.

Collectively, national underwriters (about eight of them) account for nearly 50% of total volume in a given year, followed by a 30% market share of about 18 large regional underwriters. These volume shares are higher than the corresponding deal count shares, suggesting that national and large regional underwriters tend to underwrite very large bond sales. On the other hand, small regional underwriters and single-state underwriters are numerous (97 and 111 underwriters, respectively) but tend to underwrite much smaller bond issues, collectively accounting for only 20% of the total market volume. To supplement these full sample statistics, Figure 1 plots the time series trends in underwriting activity and market share. Amid the generally increasing trend in bond issuance over time, the market share of national underwriters—already prominent—also increases, from below 40% in 2005 to about 60% in 2020 before dropping to slightly less than 50% in 2023. The loss of market share of national underwriters in 2018 and 2022–2023 tends to be offset by a corresponding increase in the market share of large regional underwriters, whereas that of small players (small regional and single state) has remained steady at a relatively low level.

Panel B of Table 2 provides some descriptive statistics of markups in the new issue market. Most bonds are distributed to investors at the offering price, as indicated by the zero median markup across all underwriter types. However, investors still buy many bonds in the new issue market at a markup from the offering price, with the average markup varying across underwriters. Compared to other underwriter types (especially single-state ones), markups are the lowest and least variable among bonds underwritten by national underwriters. More importantly, Panel A of Figure 2 shows that except for bonds underwritten by single-state underwriters, the average markup has steadily decreased over time, from the high teens in 2005 to about five bps in 2023 for all national and regional underwriters. This decline

could be due to an increased fraction of bonds distributed with zero markups and/or lower markups on bonds with non-zero markups, which we will explore in greater detail.[9]

National underwriters also seem to charge the lowest underwriting spreads (in basis points of the issue size) as reported in Panel C of Table 2, averaging approximately 75bps compared to 90bps, 112bps, and 161bps charged by large regional, small regional, and single-state underwriters, respectively. Given that national underwriters tend to underwrite larger deals than those by other underwriters, the underwriting fees in dollars they collect on an average bond sale are still the highest, but the fixed costs in underwriting are spread over a much larger volume, resulting in lower underwriting spreads per issue. Panel B of Figure 2 shows that the average underwriting spreads charged by national and large regional underwriters always stay in the 50-100bps range and appear to increase only slightly in recent years, whereas those charged by small regional and single-state underwriters are consistently higher and increased at a much faster rate.

Finally, we tally the total underwriting profit for each issue by summing the total markups charged to investors in the new issue market and the underwriting fees charged to issuers and express it in percentage of the issue size. The time series plot in Figure 3 shows a clear decline trend in the underwriting profit margin, especially after the 2008 financial crisis and especially for national underwriters. The figure also shows that such decline is most pronounced for the two exiting underwriters (UBS and Citigroup), suggesting that they were under significant profitability pressure during the sample period. Tests for the time trend in total profitability, reported in Table 3, confirm that the negative time trend

[9]Figures A.4 and A.5 plot the distribution of new issue markups and excluding bond-days with no dispersion, respectively. Figure A.6 focuses more specifically on the share of trades with some dispersion within different categories (under $25,000, [$25,000-100,000), [$100,000,250,000), and over $250,000).

is significant, with national underwriters experiencing a significantly more negative trend than other underwriters. Overall, our descriptive statistics convey a consistent picture of declining profit for underwriters in which underwriting fees have not sufficiently grown to counter the reduction in markups on new issue market trades.

4 The Decline in Underwriting Profits

The preceding section highlights several key trends in municipal bond underwriting, including the dominant presence of national underwriters, the declining markups in the new issue market for municipal bonds, and the overall downward trend in underwriting profitability. In this section, we study these trends in greater detail, carefully controlling for changes in bond characteristics and the macro environment potentially underlying the descriptive patterns discussed earlier. Specifically, we estimate a series of regressions for two outcome variables: markups in the new issue market (at the bond level) and underwriting spreads (at the issue level). Markups reflect the profit made from distributing the bonds to investors, whereas underwriting spreads (or "markdowns") represent the profit collected from the issuers.

4.1 Markups in the new issue market

The regression model for the markup on bond i issued at time t is:

$$\begin{aligned}\text{Markup}_{i,t} \;=\; & \delta'\text{Year}_t + \beta_1\text{National}_i + \beta_2'\text{National}_i \times \text{Year}_t + \beta_3\text{LnIssueSize}_i \\ & + \beta_4\text{LnBondSize}_i + \beta_5\text{Maturity}_i + \beta_6\text{Maturity}_i^2 + \beta_7\text{Coupon}_i \\ & + \beta_8\text{Premium}_i + \beta_9\text{Callable}_i + \beta_{10}\text{Insurance}_i + \beta_{11}\text{AddCredit}_i \\ & + \beta_{12}\text{BankQlf}_i + \beta_{13}\text{OfferType}_i + \gamma_1'\text{BondType}_i + \gamma_2'\text{Rating}_i \\ & + \gamma_3'\text{Proceeds}_i + \eta'\text{State}_i + \epsilon_{i,t}, \end{aligned} \tag{2}$$

where $Markup_{i,t}$ is the trade-size-weighted average markup on customer buy trades within 14 days of the offering date or until the total bond amount is fully sold, whichever is earlier. δ is a vector of year fixed effects, which capture the average markups over the years in the sample after controlling for various determinants of markups. $National$ is a dummy variable for whether a national underwriter underwrote the bond sale. We include $National$ to assess whether markups charged by national underwriters still differ from those by other underwriters after controlling for different characteristics of the bonds they underwrite.

We control for the following bond characteristics. $LnIssueSize$ and $LnBondSize$ indicate the logged issue amount and logged bond amount, respectively. $Maturity$ is the bond's maturity, and $Maturity^2$ is the squared maturity to capture any potential non-linearity. $Coupon$ is the coupon rate of the bond. Dummy variables for bonds that are issued at a premium ($Premium$), callable ($Callable$), insured ($Insured$), with additional credit enhancement ($AddCredit$), bank-qualified ($BankQlf$), and whether the offering type is negotiated ($OfferType$) are also included. Vectors of coefficients are denoted by γ on types of bonds (GO, Revenue, or Other), rating dummies, and broad use of proceeds categories (General, Higher Education, Primary Education, Water, and Other uses). The regression model also includes state and year fixed effects to control for time-invariant heterogeneity.

We plot the year fixed effects (δ_t) in Panel A of Figure 4. Each coefficient represents the average new issue markup in the corresponding year relative to the base year of 2005. Markups significantly increase after the 2008 financial crisis until 2015 before steadily decreasing to almost the 2005 level toward the end of the sample period. This plot indicates that, after accounting for differences in bonds issued over time, markups do not decline as early as indicated by the descriptive patterns shown in Figure 2, nor soon after the public

dissemination of municipal trade data in 2005, the first among several important initiatives to improve muni market transparency.[10]

Panel B of Figure 4 shows the differential markups on bonds underwritten by national underwriters over time. These are the estimates for β_2 from Equation (2) above. For most of the years, markups by national underwriters are significantly lower than those by other underwriter types, consistent with unconditional summary statistics even after controlling for a comprehensive list of bond controls and fixed effects. It is possible that national underwriters have better access to institutional investors who tend to get better terms of trade. Indeed, our analysis provided in Figure **??** shows that the share of institutional sized trades in the new issue market is highest among bonds underwritten by national underwriters. Moreover, this share has risen over time, from around 70% in 2005 to nearly 90% in 2023, which could contribute to the lower and declining markups of national underwriters.

4.2 Underwriting Spreads

The regression model for underwriting spreads on bond issue j issued at time t is:

$$\begin{aligned} \text{UndSpread}_{j,t} \;=\; & \delta' \text{Year}_t + \beta_1 \text{National}_j + \beta_2' \text{National}_j \times \text{Year}_t + \beta_3 \text{LnIssueSize}_j \\ & + \beta_4 \text{Callable}_j + \beta_5 \text{Insurance}_j + \beta_6 \text{AddCredit}_j \\ & + \beta_7 \text{BankQlf}_j + \beta_8 \text{OfferType}_j + \gamma_1' \text{BondType}_j + \gamma_2' \text{Rating}_j \\ & + \gamma_3' \text{Proceeds}_j + \eta' \text{State}_j + u_{j,t}, \end{aligned} \tag{3}$$

where the control variables are as explained for Equation (2). Because the underwriting spread is an issue-level outcome variable, this regression model does not contain bond-level

[10] Figure A.7 in the Online Appendix plots analogous coefficients of the interaction between National Underwriter × Year for general obligation (GO) bonds. A similar pattern emerges: markups declined over time. Figure A.8 plots similar coefficients when the outcome variable is the percent spread for GO bonds.

variables. Similar to our regression analysis of markups, we plot in Figure 5 the estimated year fixed effects and their interactions with the National underwriter dummy to expose the average underwriting spreads over time after accounting for possible variation in issuance characteristics and cross-sectional variation across states.

Panel A of Figure 5 reveals a trend in underwriting spreads somewhat opposite that of markups, with spreads declining in the post-2008 crisis period (when markups were rising) but starting to increase from 2016 until the present (when markups were declining). The evidence seems to suggest a preference for stable underwriting profitability and that shortfalls on one side appear to be made up for with some increased profits on the other side. However, as shown in Panel B of Figure 5, underwriting spreads are significantly lower for national underwriters than for other underwriters and trend down over time, along the similar trend in markups shown in Panel B of Figure 4. Collectively, these plots paint a consistent picture of declining profits for national underwriters, with the decline starting long before the emergence of ESG-related sentiment in recent years.

5 Why Do Underwriting Profits Decline?

In this section, we investigate the channels behind the declining profitability of national underwriters documented in the previous sections. Green (2007)'s model points to increased investor sophistication, either through a decrease in the mass of retail investors (μ) or an increase in their informedness (q), as a direct driver of decreased underwriter profitability. There are reasons to believe that both of these trends are at work. First, as previously discussed, institutional investors (investment funds and SMAs that manage muni assets on

behalf of retail investors) increasingly participate in the muni market in recent years. Second, with greater market transparency and greater public availability of municipal securities primary offering documents and secondary market trading information, the cost of becoming informed for retail investors has fallen significantly (see e.g., Wu, 2018 for evidence).

While anecdotal and descriptive evidence abounds, it is challenging to measure the mass of retail investors and how informed they are—the two key constructs in Green (2007)'s model—because they are unobservable. Nevertheless, to the extent that informed and uninformed investors likely obtain different trade terms, we can employ latent class models on observed markups and let the data separate these investor types. Below, we describe the model and present key findings based on the model estimates. With a long sample period until the end of 2023, we offer a time series perspective on muni investor sophistication, thereby complementing the initial results in Green et al. (2007) which are based on a small sample of bonds issued between 2000–2003. The time series evidence helps deepen our understanding of changes in the muni market and their implications for investor sophistication, which might affect the financial health of underwriters and the future of municipal finance.

5.1 Structural Estimation of Markups

We estimate a latent class model—a finite mixture of regression models with latent categorical classification. The first part of the model is the classification regression, which classifies a trade as either an informed or uninformed investor based on observable variables prevailing at the time of the trade. The outcome regression corresponds to the observed markup, drawn from one of the two regimes determined endogenously by the classification regression.

Our empirical specification is based on the same economic foundation of Green et al. (2007). Specifically, there are two classes of investors in the primary market: informed and uninformed. An investor decides to become informed if the benefit of being informed, e.g., better terms of trade, exceeds the cost of information acquisition. Denote by z_i^* the net benefit of being informed, which is latent but modeled as a function of observable bond and trade characteristics ω_i, i.e., $z_i^* = \omega_i\delta + u_i$. The markup each type ($U$ for uninformed and I for informed) pays on trade i is also a linear function of observable characteristics x_i:

$$y_i^U = x_i\beta^U + \epsilon_i^U, \tag{4}$$

$$y_i^I = x_i\beta^I + \epsilon_i^I. \tag{5}$$

The observed markup y_i for trade i is thus:

$$y_i = \begin{cases} y_i^U & \text{if } z_i^* < 0 \\ y_i^I & \text{if } z_i^* \geq 0 \end{cases} \tag{6}$$

Following Green et al. (2007), the conditioning variables x_i in the markup regressions of our model include observable bond characteristics (as used in Equation (2)) as well as trade characteristics such as trade size, the days since the offering, and the percentage of the issue that has been sold prior to the trade. The set of conditioning variables ω_i used in the classification regression includes all conditioning variables in the outcome regressions listed above, as well as the following: a dummy for whether the issuer is a first-time issuer, the number of issues sold prior to this bond sale by the issuer, and the underwriting spread. The first two added variables capture the information asymmetry of the issue, which are arguably

important considerations when an investor decides whether to become informed or not. The inclusion of the underwriting spread reflects the trade-off between markups and markdowns as underwriters optimize their markup strategy, which likely affects the investor's net benefit of becoming informed. Most importantly, we add the dummy for *National Underwriter* in both parts of the model to account for the potential that national underwriters have different investor clientele and markup/markdown strategy, as indicated by our evidence so far.

We use the expectation-maximization (EM) algorithm to obtain reasonable starting values and then estimate the entire system via maximum likelihood. We estimate the model separately for each consecutive non-overlapping two-year period beginning in 2006–2007 and ending in 2022–2023. Consistent with the regressions in Section 4, the estimation is based on all trades for rated bonds of all types within 14 days of the offering date, or until the total bond amount is fully absorbed by customer buy orders, whichever is earlier.[11] The estimated model gives us the time series of two important measures: the probability of uninformed trades (which maps to the mass of retail investors in Green, 2007) and the average markup conditional on uninformed trades (with a lower markup mapping to greater informedness of retail investors in Green, 2007), along with the corresponding standard errors.

5.2 Time Series Results

We plot the proportion of uninformed trades and their standard errors in Figure 6. The likelihood of facing an uninformed trader decreases steadily over the entire sample period, from 55.5% in 2006–2007 to 25.2% in 2022–2023. At the same time, markups charged to

[11] We also perform the estimations separately for GO and revenue bonds and over a fixed window, with virtually identical results.

uninformed investors have fallen dramatically, as shown in Figure 7. From a high of 152 bps in 2008–2009, average markups for uninformed investors have fallen to about 96 bps by the end of the sample period, a decline of over 36%. In other words, over the last two decades or so, underwriters have faced an increasing proportion of informed traders (who pay zero markups), while the much smaller proportion of uninformed traders they face are paying average markups over a third lower.[12]

Figure 8 builds on these results by presenting the coefficients on the National Underwriter dummy in the classification regression. Controlling for trade and other bond characteristics, these coefficients capture the effects of national underwriters on the probability of encountering uninformed investors in selling the bonds they underwrite in the new issue market. While we cannot reject the null that national underwriters are no less likely than their counterparts to face uninformed investors at the beginning of our sample, we find they are between 0.10 to 0.40 percentage points less likely to trade with uninformed investors in the latter part of the sample. Furthermore, Figure 9 shows that national underwriters also have significantly lower markups on uninformed trades than regional underwriters for most of the sample period.[13]

Finally, the inclusion of underwriting spreads in the classification equation allows us to investigate whether spreads charged to the issuer and markups charged to uninformed investors are complements or substitutes. We plot the coefficient of underwriting spreads in the classification equation over time in Figure A.13. The significantly negative coefficient in all periods shows that these two sources of income for underwriters are strong substitutes. Issues

[12]Figure A.9 in the Online Appendix plots the probability of an informed trade for revenue bonds, which are riskier bonds since they are linked to project-specific revenues (rather than GO bonds that are backed by general taxing power). The results are analogous: the probability of informed trades has grown from 40% to roughly %70.

[13]Figure A.10 in the Online Appendix plots the markup of trades, conditional on being uninformed for revenue bonds. These markups have declined considerably over time too.

with high underwriting spreads are less likely to be sold to uninformed investors, reflecting a weaker incentive to collect profit from markups on uninformed trades. An alternative way to interpret this result is that the more likely an underwriter is to encounter retail investors (based on its retail distribution network, or μ in Green, 2007) and make profitable trades, the lower the underwriting fees it charges the issuer, enabling the underwriter to be competitive vis-a-vis other underwriters. Over time, however, this substitution effect appears to lessen as the probability of encountering uninformed investors declines significantly. In contrast, competitive pressure prevents underwriting spreads from rising fast enough to compensate for the reduced likelihood of profitable trades.[14]

5.3 The Role of Transparency

The secular decrease in the fraction of uninformed investors in the new issue market coincides with the increase in market transparency over time. Real-time transaction reporting commenced in January 2005 (the beginning of our sample), followed by continued efforts by the MSRB and SEC to improve transparency ever since. Although we cannot directly measure the degree of market transparency to establish a direct linkage between transparency and our documented evidence of increasing investor sophistication, there are important rules implemented by the SEC and MSRB that significantly increase market transparency (Wu, 2018). We can thus study how markups and search costs for investors change around these rules to better understand the role of market transparency in shaping the time series changes

[14]Figure A.11 plots the probability of an informed trade for all bonds until absorbed, showing a systematic increase from 44% to 75%. Conversely, Figure A.12 plots the average markup, conditional on an uninformed trade, for all bonds until absorbed, displaying a large decline. Finally, Figure A.13 plots the underwriter spreads in the classification equation for the probability of a trade with an uninformed investor. These spreads have decreased and increased slightly over time.

in investor informedness we have documented.

Specifically, we exploit the implementation of amended SEC Rules G-15, G-30, and FINRA Rule 2232 in May 2018 as a shock to transparency. These rules required dealers to disclose the markup that they receive in certain primary market transactions with investors. To measure implied search costs for investors, we use the price dispersion as discussed in Green et al. (2007). The price dispersion is computed as the standard deviation of trade prices in a given bond in the new issue market.

We add a *Post* dummy variable reflecting the post-policy change as well as its interaction with the *National* dummy to the regression model in Equation (2) for markups and a similar regression model for the price dispersion. We remove the *Year* x *National* fixed effects. Table 4 presents the results. Panel A shows that a positive shock to transparency dramatically reduced the markups charged in the primary market by national underwriters. This finding is consistent with He (2024) who finds that trading costs for retail investors decreased after the markup disclosure rule. In line with the descriptive evidence presented in Figures 2 and 4, while national underwriters have pricing power and potentially a larger unsophisticated retail network in the earlier years of the sample, the markups they charge decline substantially after the implementation of markup disclosures in May of 2018. In Panel B, the price dispersion also decreases significantly for national underwriters, suggesting that this transparency shock has contributed to lower search costs for their investors. Thus, both panels convey that transparency makes it easier for investors to become informed, thereby reducing underwriters' ability to charge high markups. Both of these effects are consistent with our evidence of decreased probability of uninformed and the lower markups charged on uninformed trades.

5.4 Money Left on the Table

To quantify the economic effects of the changing investor sophistication on underwriting profitability, we estimate the "money left on the table" (MLOT), which reflects the profit underwriters earn from trading with uninformed investors. While underwriting spreads are immediately observable, markups collected from distributing bonds to investors constitute the much less transparent component of underwriters' profit. MLOT provides additional insight into the components of underwriting profit and how they have evolved over time.

Following Green et al. (2007), we compute MLOT as follows. First, using the estimated classification equation, we classify each trade as informed or uninformed, based on whether the conditional net benefit $E(z_i^*|\omega_i)$ is greater than 0 or not. For each trade classified as uninformed, we compute the difference in the conditional expected markup between an uninformed and an informed investor, i.e., $MLOT_i = E(y_i^U - y_i^I|\omega_i, x_i, z_i^* < 0)$. We then aggregate the dollar amount of trade-level MLOTs (i.e., $MLOT_i \times TradeSize_i$) across all trades in a given bond to obtain the bond-level MLOTs, and then further aggregate them to the issue level to obtain the issue-level MLOTs.

Table 5 reports MLOTs estimates by year. The first column, which presents the average MLOT per transaction in basis points, shows an increase from roughly 130 bps in 2006 to 179 bps both 2008 and 2009, and then consistently declining to 105 bps in 2023. The second and third columns report the bond- and issue-level MLOTs expressed in basis points of the bond and issue par amount, respectively. On average, uninformed traders leave \$0.5742 per \$100 of par value per bond, and \$0.1774 per \$100 par value per issue on the table. These averages mask the fact both bond and issue MLOTs have fallen dramatically over time, collectively

exhibiting a 61.1% and 72.4% declines from their highs in 2008.

If the issue-level MLOTs reported in the third column reflect the profit obtained from distributing bonds to uninformed investors, the underwriting spreads reflect the profit collected directly from the issuer. Unlike MLOTs, underwriting spreads appear more stable over time, at roughly 80 bps of the issue size. We convert both profit components to dollar amounts and compute the dollar MLOTs in percent of the total profit for each given issue, which we report in the fifth column. MLOTs as a source of profit for underwriters have sharply declined over time, falling nearly monotonically from a high of 23.65% (2008) to 7.36% in the last year of the sample.

Overall, the evidence in this section clearly suggests that muni investors have become increasingly more informed. Both the probability of trading with uninformed investors and the markups charged on uninformed trades have significantly declined. These changes, in turn, shrink the amount of money left on the table by uninformed investors. Meanwhile, competition among underwriters keeps underwriting spreads from increasing to make up for the shrinking profit from the new issue market. Thus, as the muni market becomes more transparent, underwriters' total profits have become much more compressed.

6 Model Application: Evaluating Trade Size Cutoff

Another important advantage of our empirical model is that we can study in depth the association between trade size and the latent classification of trades as either informed or uninformed. In many studies regarding municipal markets, trade size is typically used as the device to delineate retail from institutional investors, mainly for highlighting the difference

in the level of information each type possesses. The most common threshold for such classification is $100,000. Analyzing transaction costs in the muni market, one of the earliest and most influential studies to employ the $100,000 threshold to differentiate between retail and institutional trades is Harris and Piwowar (2006).[15] The SEC also adopts this threshold in rule 15-c2-12, which considers investors with minimum denominations of $100,000 as "sophisticated" (see Ivanov et al., 2024). Because our model classifies, at the trade level, whether the investor is informed or uninformed, we can assess if the trade size classification is appropriate when the goal is to differentiate on the level of investor's informedness.[16]

Specifically, we examine how strongly trade size and the probability of the investor being uninformed are related. If trade size is a reasonable means to classify informed and uninformed trades, the correlation should be strongly negative and the rate of correct classification (i.e., the fraction of uninformed trades among trades below $100,000 and the fraction of informed trades among trades above $100,000) should be closer to 1. We tabulate this analysis in Table 6.

For each trade size category, we report the percentage of uninformed trades, which indicates the correct classification rate for trades under $100,000 (column 1) but incorrect classification for trades above $100,000 (column 4). Column 1 reveals that the percentage of trades below $100,000 being correctly classified as uninformed trades is about 61% on average over the full sample period, but this rate clearly decreases over time, falling below 50% after 2018. In addition, column 4 shows a non-trivial proportion of trades above $100,000

[15]Other notable papers include Hong and Warga (2004), Green et al. (2006), Schultz (2012), Cuny (2017), and Hendershott et al. (2020).

[16]It is important to point out that in Green (2007)'s model, the relevant distinction is between being informed versus uninformed rather than between retail versus institutional. In the model, due to the choice of becoming informed, informed retail investors obtain the same trade terms as institutional investors and thus are indistinguishable from the latter when it comes to the observed markups.

that are not informed, ranging from 38% at the beginning of the sample period to about 14% at the end of the sample period. Even though the quality of classification improves over time for trades above $100,000, the deterioration in the correct classification rate for trades below $100,000 suggests that the $100,000 cutoff is increasingly inappropriate for separating uninformed and informed trades.

We also compute the point-biserial correlation betwween trade size and uninformed trade and report these correlations separately by year for trades below and above the cutoff (see columns 2 and 5 of Table 6). While always negative (as theory would predict), the magnitude of this correlation is always below .1 for trades above $100,000 and hovers slightly above .1 for trades below $100,000 for most years of the sample, with an overall average of -.128. This suggests that even across the entire distribution, trade size is not highly correlated with the probability of investor informedness.

Another metric to evaluate the appropriateness of the trade size cutoff in correctly separating trades into uninformed versus informed is the total variation distance (TVD) between the informed and uninformed distributions. TVD is a symmetric measure bounded between 0 and 1 that can broadly be interpreted as the total probability mass needed to "shift" from one distribution to the other in order to equalize them (Gibbs and Su, 2007). A lower value indicates that the two distributions are similar, whereas a high value indicates that they are different. This measure, reported in columns 3 and 6 of Table 6, shows again that the distance between the uninformed and informed trade distributions is declining dramatically over time and is much lower below $100,000 trade sizes than above. The informed and uninformed distributions are nearly twice as "close" to each other below $100,000 compared to above. This finding indicates that it is increasingly harder to delineate uninformed from

informed trades, especially among those under the cutoff.

We zoom in on trades below $100,000 and plot the overlapping distributions of uninformed and informed trades for the entire sample period using bin sizes of $5,000 in Panel A of Figure 11. While there is a predominance of uninformed trades, there is a very substantial percentage of informed trades. At some trade sizes (e.g., $25,000 and $50,000), informed trades have even higher probability than uninformed trades. Furthermore, we conduct multiple testing across quantiles of the informed and uninformed distributions as in Goldman and Kaplan (2018). Panel B of Figure 11 depicts the empirical CDFs for each distribution, and the quantiles where we can reject equality of the CDFs (the bolded black bar on the x-axis) at a 5% familywise error rate. Importantly, round trade sizes of $25,000, $50,000, and $75,000 are areas of the distribution where we can **not** reject equality. This finding suggests that a much more improved method of using trade size to proxy for uninformed trade would use only non-"round" trade amounts below a $100,000 threshold. Even then, the results on correlation and TVD indicate that there could still be substantial misclassification.

Overall, the results in this section demonstrate that the correlation between trade size and whether the investor is informed is weak and declines over time. For trades under $100,000, the distributions of informed and uninformed trades are increasingly indistinguishable, with similar probabilities at "round" trade sizes. Our analysis emphasizes that, at least in the primary market we investigate here, using the $100,000 trade size threshold to classify informed or uninformed trade is problematic.

7 Conclusion

Our study provides a comprehensive analysis of the dynamics of the municipal bond market from 2005 to 2023, displaying large shifts in market structure, underwriting practices, and profitability trends. In particular, underwriting profits have dramatically declined over time as underwriters face increasingly compressed markups charged to investors, whereas underwriting fees charged to issuers are also constrained due to competition among underwriters.

We investigate the underlying mechanisms for the declined profitability, especially the markups, using a structural model along the line of Green et al. (2007). Our estimates show that underwriters are half as likely over the time span of our sample to encounter an uninformed retail investor when selling an issue, and the markups they can charge these dwindling investors have fallen by a third. These findings are consistent with the increased institutionalization of the muni investor base, reflected in the increased participation of institutional investors and institutional-like managed accounts. Furthermore, regulatory transparency enhancements and technological advancements have reduced information asymmetries, which naturally compresses the markups underwriters can charge, even to uninformed investors. Thus, even though the greater market transparency is beneficial to investors, our results highlight a potential unintended consequence with respect to muni issuers, who do not seem to benefit from such increased transparency if it contributes to driving underwriters out of the market as predicted by Green (2007).

Finally, our estimates facilitate an evaluation of the appropriateness of the $100,000 trade size cutoff commonly used to distinguish between retail and institutional trades. We show

that such a cutoff becomes increasingly problematic due to increased investor sophistication over time, especially for research questions concerning differential levels of informedness across investor types. Overall, our paper contributes to a better understanding of the key drivers of underwriting profits, provides theory-founded estimates of probability of uninformed trades as a metric of investor sophistication in the muni market, and offers some caution regarding the use of the widely adopted trade size threshold to separate informed and uninformed trades with a practical empirical approach from a latent classification model.

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Table 1: Sample construction and data filters

This table shows the filters applied in constructing the bond sample and the bond-trade sample. Bond data are from the Mergent municipal fixed-income database. Trade data is from the MSRB. We only consider trades in the new issue market, defined as those within [-30 days; + 14 days] of the offering date or when the bond size is fully absorbed by customer buy trades, whichever is earlier. The sample period is from 2005 to 2023.

Filters	# Issues	# CUSIPs	# Trades
Full Mergent sample	509,163	4,596,452	
Bonds issued since 1/1/2005 and not by US territories	309,283	2,672,141	
0<offering yield<50% and 50<offering price<150		2,565,007	
0<coupon<20% and offering size>0		2,523,419	
Debt-type="BND" and face value = 100		2,299,523	
Fixed rate coupon		2,298,466	
Purpose of issuance either NEW or REF		2,286,565	
Remove bonds with offering date after maturity date		2,286,456	
Underwriter information available	189,373	2,275,525	
Merged with MSRB trade data:			
New issue trades ([-30;+14] of offering date)			18,308,872
Remove trades of less than $5,000 par			18306987
$50 \leq$ trade price ≤ 150	183,502	2,076,767	18,306,168
Sample for new issue markup analysis:			
Customer buy trades [0; +14] of offering date	183,502	2,076,767	12,389,917
Sample for underwriting spread analysis:			
Issues with underwriting spread data	132,588		

Table 2: Summary statistics of underwriting activity, markups, and spreads

This table reports summary statistics of underwriting activity, markups, and spreads by underwriter type. Underwriters are classified based on how many states they underwrite in a given year: "single state" if one state, "small regional" if between 2 and 19 states, "large regional" if between 20 and 39, and "national" if 40 and above. Panel A reports the summary statistics of underwriting activity in an average year. Panel B presents summary statistics on bond-level markups in the new issues market. Markup is defined as the difference between the customer purchase price and the offering price of the bond, expressed in basis points of the latter. New issue market trades are defined as customer buy trades within 14 days of the offering date. The markup for a given bond is the trade-size-weighted average of markups across all new issue trades in the bond. Panel C shows the summary statistics of underwriting spreads (expressed in basis points of the total issuance amount). Data sources: Mergent municipal fixed income database, MSRB trade data, SDC Platinum, and Bloomberg. Sample period: 2005–2023.

	Single-state	Small regional	Large regional	National
Panel A: Average annual underwriting activity				
Number of states served	1.00	6.87	27.75	44.24
Number of deals per underwriter	6.67	53.48	254.92	654.91
Volume ($m) per underwriter	66	615	5,517	18,509
Number of underwriters	111	97	18	8
Market share (% deal count)	4.65	32.47	28.02	34.86
Market share (% volume)	2.29	18.56	30.16	48.99
Panel B: Markups in the new issues market				
Mean markup (bps)	22.49	14.91	14.38	13.76
Median markup (bps)	0.00	0.00	0.00	0.00
StDev markup (bps)	70.47	61.65	62.19	58.25
Average bond size ($m)	0.66	0.95	3.27	4.39
Number of bonds	100,026	598,503	520,128	802,981
Panel C: Underwriting spreads				
Mean spreads (bps)	160.99	111.99	89.95	74.84
Median spreads (bps)	126.70	89.80	69.90	60.60
StDev spreads (bps)	130.47	88.88	91.26	61.30
Average issue size ($m)	7.00	10.04	37.99	56.08
Number of issues	11,428	63,398	49,106	65,441

Table 3: Tests of Time Trend in Underwriter Profitability

This table reports test results for the time trend in underwriter profitability over the full sample period and sub-sample periods after the 2008 financial crisis. Underwriting profitability is computed as the sum of dollar underwriting spreads and total dollar markups from trades with investors in the new issue market, expressed in percentage of the issue size. *National* is an indicator for whether the underwriter of the issue underwrote issues in 40 or more states in a given year. The regressions also control for issue characteristics including issue size, rating, use of proceeds, offering type, bond type (GO, revenue, or other), average coupon rate, average maturity, state fixed effects, whether the issue is insured, has additional credit enhancement, and contains callable bond. Bond issue data is from the Mergent municipal fixed income database, trade data is from the MSRB, underwriter spreads (as a percent of issue size) are from SDC Platinum and Bloomberg. For markups, we consider only trades in the new issue market, defined as those within 14 days of the offering date or when the bond size is fully absorbed by customer buy trades, whichever earlier. The sample period is from 2005 through December 2023.

	Full Sample	Post-2008	
	2005–2023	2009–2023	2009–2019
Time trend	0.137***	-1.046***	-1.786***
	(0.047)	(0.065)	(0.091)
Time trend × National	-1.055***	-0.681***	-0.603***
	(0.071)	(0.094)	(0.138)
Issue Characteristics	Yes	Yes	Yes
Offering Type	Yes	Yes	Yes
State FEs	Yes	Yes	Yes
Nobs	105,128	89,236	67,922
Adj. R^2	0.328	0.355	0.344

Table 4: Markups and Price Dispersions Around Markup Disclosure Rule

This table reports results for regressions of markups (Panel A) and price dispersion across trades in the same bond (Panel B) in the new issue market around the implementation of the markup disclosure rule. *National* is a dummy variable for the underwriter's geographic breadth, indicating that the underwriter of the issue underwrote issues in 40 or more states in a given year. *Post-Markup Rule* indicates the period after SEC amended rules G-15 and G-30 and FINRA Rule 2232 on markup disclosure become effective May 2018. Bond issue data is from the Mergent municipal fixed income database, trade data is from the MSRB, underwriter spreads (as a percent of issue size) are from SDC Platinum and Bloomberg. For markups, we consider only trades in the new issue market, defined as those within 14 days of the offering date or when the bond size is fully absorbed by customer buy trades, whichever earlier. The sample period is from 2005 through December 2023. Regressions include state and year fixed effects, use of proceeds dummies, and ratings dummies for narrow rating categories. Standard errors are clustered by issue.

Panel A: New Issue Markup %

	All Bonds	GO Bonds	Issue $100m+	GO & $100m+
National	0.012***	0.023***	0.028***	0.045***
	(4.78)	(6.97)	(4.14)	(3.17)
National x Post Markup Rule	-0.041***	-0.055***	-0.037***	-0.041**
	(-10.77)	(-10.33)	(-4.42)	(-2.55)
Post Markup Rule	0.004	0.006	0.004	0.013
	(0.67)	(0.71)	(0.29)	(0.63)
Bond Controls	Yes	Yes	Yes	Yes
Proceeds Dummies	Yes	Yes	Yes	Yes
Ratings Dummies	Yes	Yes	Yes	Yes
State and Year FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.114	0.106	0.063	0.064
Observations	1,705,648	1,006,900	192,744	59,501

Panel B: Price Dispersion

	All Bonds	GO Bonds	Issue $100m+	GO & $100m+
National	0.019***	0.018***	0.026***	0.033***
	(12.92)	(9.40)	(6.03)	(3.48)
National x Post Markup Rule	-0.036***	-0.033***	-0.027***	-0.034***
	(-13.24)	(-8.76)	(-3.48)	(-2.28)
Post Markup Rule	-0.004	-0.001	-0.015	-0.006
	(-0.84)	(-0.20)	(-1.57)	(-0.36)
Bond Controls	Yes	Yes	Yes	Yes
Proceeds Dummies	Yes	Yes	Yes	Yes
Ratings Dummies	Yes	Yes	Yes	Yes
State and Year FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.190	0.186	0.218	0.207
Observations	1,034,792	553,016	161,047	46,565

Table 5: Money Left On The Table by Uninformed Trading

This table reports the amount of money left on the table by uninformed trading, using estimates from the two latent class finite mixture regression model applied to rated bonds for two year periods over the sample. Money left on the table (MLOT) is defined as the average expected difference between uninformed and informed trades, conditional on trading by an uninformed trader. The first column presents the average MLOT per transaction in basis points. The second and third columns are the percent of the bond and issue respectively generated by aggregating the dollar amounts of MLOT. The fourth column is the underwriting spread (in bp) for the issues in the sample, and the last column presents the percentage MLOT of the total issue profit, where total issue profit is defined for each issue as the sum of MLOT and underwriting spread.

	Money Left On The Table				
Year	Per Trade (bps)	Per Bond (bps of Par)	Per Issue (bps of Par)	Underwriting Spread (bps)	MLOT in % of Total Profit
2006	130.30	48.58	20.11	73.64	18.49
2007	129.02	48.58	20.03	73.67	17.72
2008	179.61	70.20	31.55	77.39	23.65
2009	179.43	60.52	24.44	86.16	17.69
2010	173.84	65.48	22.45	82.89	17.09
2011	178.75	68.56	23.32	84.70	17.93
2012	172.87	62.97	18.52	79.90	15.31
2013	178.57	68.24	19.63	78.22	16.30
2014	160.92	62.58	18.04	75.10	15.67
2015	164.59	65.36	20.18	71.56	18.05
2016	154.56	60.29	17.76	69.97	16.22
2017	151.47	61.41	17.91	75.96	15.63
2018	124.82	45.45	13.32	81.53	12.15
2019	122.73	50.66	14.96	75.55	13.67
2020	114.55	52.35	12.14	78.73	10.58
2021	106.65	46.55	10.03	76.21	9.37
2022	103.42	33.24	9.80	85.61	7.62
2023	105.35	27.79	8.71	80.15	7.36
Average	157.99	57.42	17.74	77.79	14.99
Observations	3,518,076	360,105	101,724	101,724	101,724

Table 6: Statistics on the Distribution of Uninformed Trades

This table reports statistics for the relative distribution of the posterior probabilities of informed and uninformed trades computed from the structural model described in Section 5. The sample is split by trade sizes above and below 100,000, and statistics computed separately for each category and year. The first column of each category is the percentage of trades that are uninformed and the second column reports the biserial correlation coefficient between trade size and the indicator for uninformed trade. The third column reports the total variation distance (TVD) between the informed and uninformed probability distributions and represents the symmetric amount of probability mass needed to transfer in order to equalize the two distributions. Below trade sizes of 100,000, the pdf is computed from a discretization using 20 bins and for trade sizes above the pdf is computed using a kernel density estimator with a grid size of 100 and the Parzen kernel.

Uninformed Trade Distribution

	Trades < 100k			Trades >= 100k		
	% Uninformed	Correlation	TVD	% Uninformed	Correlation	TVD
2006	67.29	-0.120	0.141	38.27	-0.094	0.181
2007	66.60	-0.113	0.129	36.36	-0.075	0.184
2008	69.07	-0.104	0.118	36.74	-0.072	0.206
2009	65.85	-0.137	0.150	31.25	-0.083	0.180
2010	65.41	-0.170	0.171	26.82	-0.068	0.175
2011	67.46	-0.156	0.156	26.41	-0.073	0.219
2012	64.46	-0.154	0.140	22.77	-0.085	0.220
2013	61.03	-0.113	0.097	22.59	-0.074	0.231
2014	54.78	-0.101	0.086	20.66	-0.072	0.227
2015	65.31	-0.110	0.088	24.76	-0.092	0.251
2016	65.02	-0.158	0.145	23.88	-0.086	0.245
2017	61.00	-0.153	0.144	21.05	-0.070	0.255
2018	50.66	-0.127	0.112	20.11	-0.057	0.216
2019	49.46	-0.091	0.076	21.17	-0.057	0.157
2020	41.16	-0.136	0.124	14.51	-0.052	0.131
2021	36.02	-0.098	0.097	13.36	-0.035	0.123
2022	40.63	-0.054	0.099	13.79	-0.052	0.209
2023	42.82	-0.071	0.090	14.01	-0.063	0.260
Full Sample	61.36	-0.128	0.122	23.32	-0.070	0.224

Figure 1: Underwriting activity by underwriter type over time

The figure shows the time series variation in underwriting activity. Underwriters are classified based on how many states they underwrite in a given year: "single state" if one state, "small regional" if between 2 and 19 states, "large regional" if between 20 and 39, and "national" if 40 and above. The upper panel shows the number of deals (left axis) and the fraction underwritten by each underwriter type (right axis). The lower panel shows the total underwriting volume (in $ billion, left axis) and the fraction of volume underwritten by each underwriter type (right axis). Data source: Mergent municipal fixed income database. Sample period: 2005–2023.



Figure 2: Time series variation in markups and spreads by underwriter type

This figure presents the average markups and spreads over time by underwriter type. Underwriters are classified based on how many states they underwrite in a given year: "single state" if one state, "small regional" if between 2 and 19 states, 'large regional" if between 20 and 39, and "national" if 40 and above. Panel A shows the year-by-year average bond-level markups over offering price in the new issue period (within 14 days of the offering date). Panel B plots the year-by-year average underwriting spreads. Data sources: Mergent, MSRB, SDC Platinum, and Bloomberg. Sample period: 2005–2023.

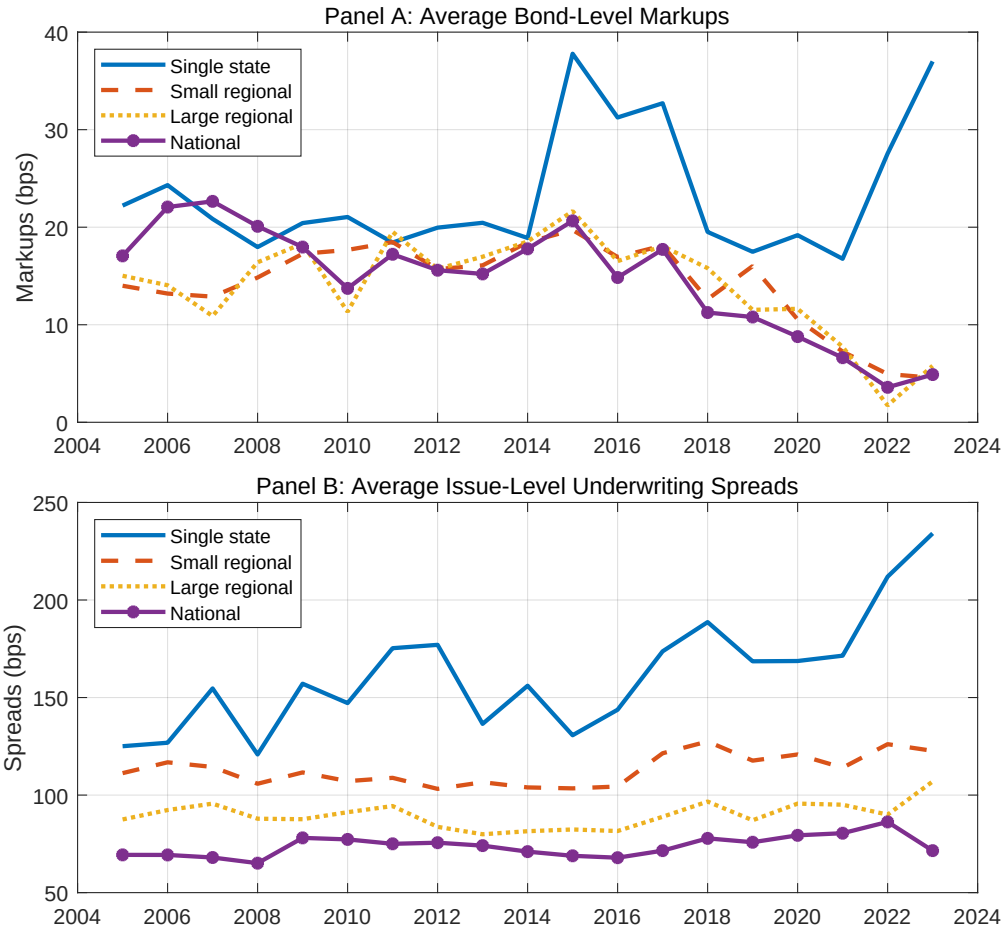
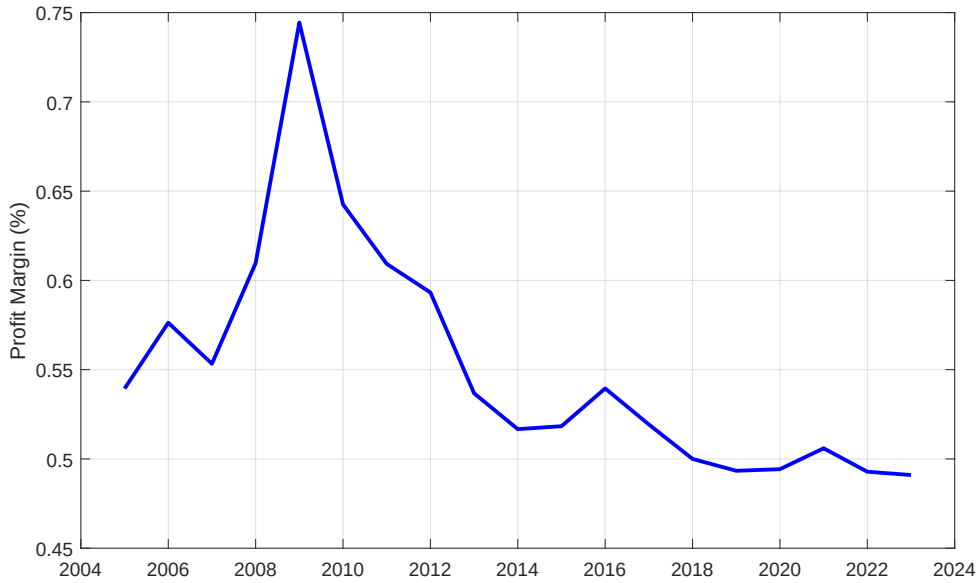
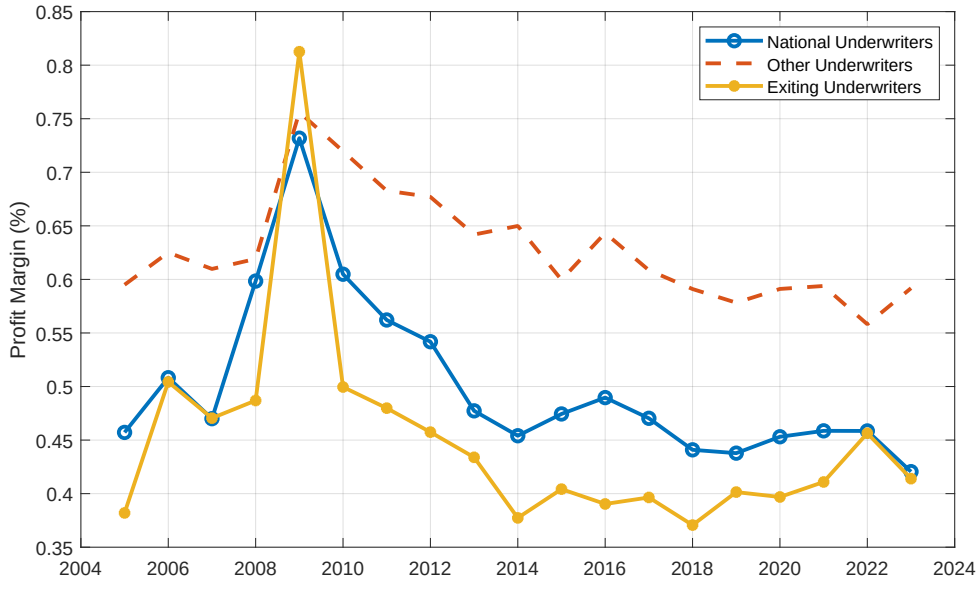


Figure 3: Underwriting Profit Over Time

The figure plots the time series variation of underwriting profit margin. It is underwriting profit expressed in percentage of issue size. Underwriting profit includes dollar underwriting fees charged to the issuer and markups charged to investors in the new issue market (i.e., trades within 14 days of issuance or until the total bond amount is fully sold, whichever earlier). Panel A shows the yearly averages across all underwriter types, whereas Panel B shows similar statistics separately for national underwriters, exiting national underwriters (UBS and Citigroup), and other underwriters. National underwriters are those that do business in 40 or more states in a given year. Data sources: Mergent municipal fixed income database, MSRB trade data, SDC Platinum, and Bloomberg. Sample period: 2005–2023.



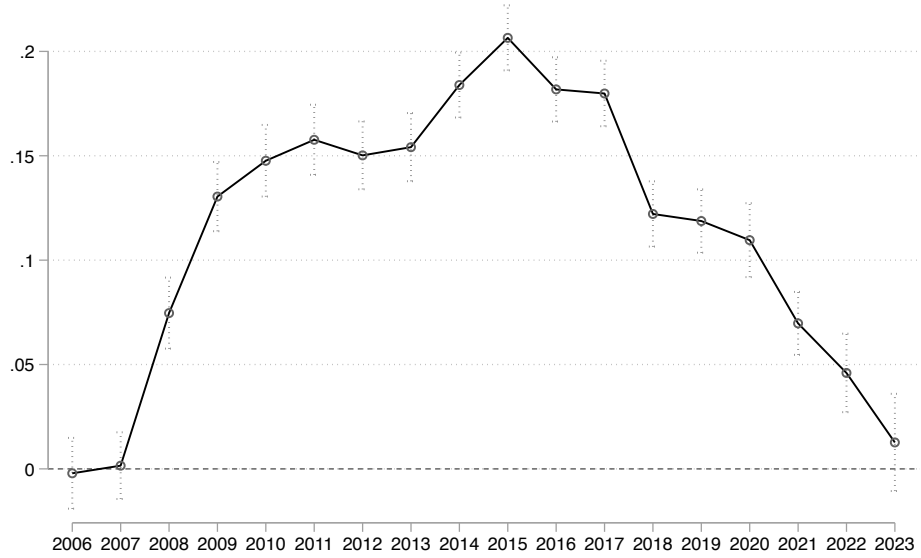
Panel A: All Underwriters



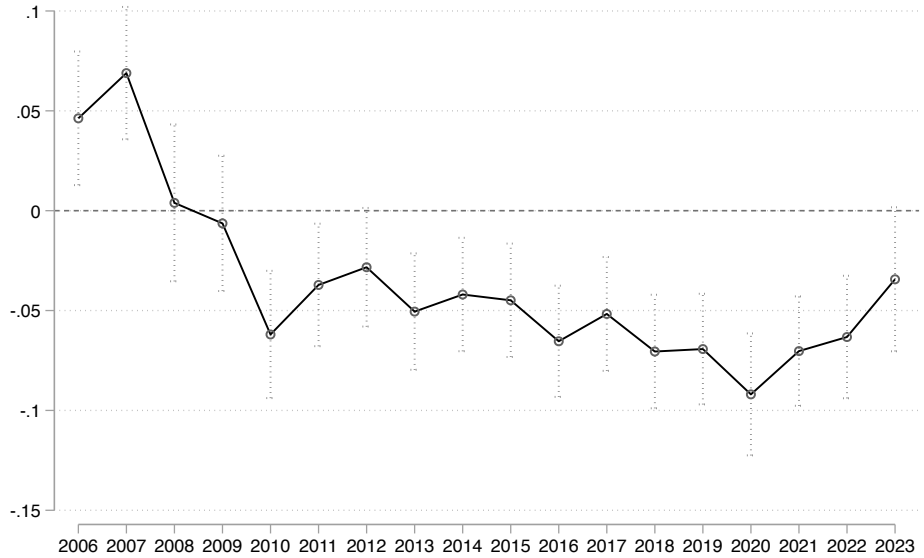
Panel B: By Underwriter Type

Figure 4: Regression Analysis of Markups Over Time

The figure shows the average markups over time after controlling for determinants of markups using the regression model in Equation (2). Panel A plots the Year fixed effects. Panel B plots the National x Year fixed effects. Markup on a customer buy trade is computed as the difference between the price paid and the offering price of the bond, expressed as a percentage of the offering price. The average markup in the new issue market for a given bond is the trade-size-weighted average markups on all trades in that bond within 14 days of issuance or until the total bond amount is fully sold, whichever earlier. Underwriters are classified based on how many states they underwrite in a given year. National underwriters are those that do business in 40 or more states in a given year. Data sources: Mergent municipal fixed income database and MSRB trade data. Sample period: 2005–2023.



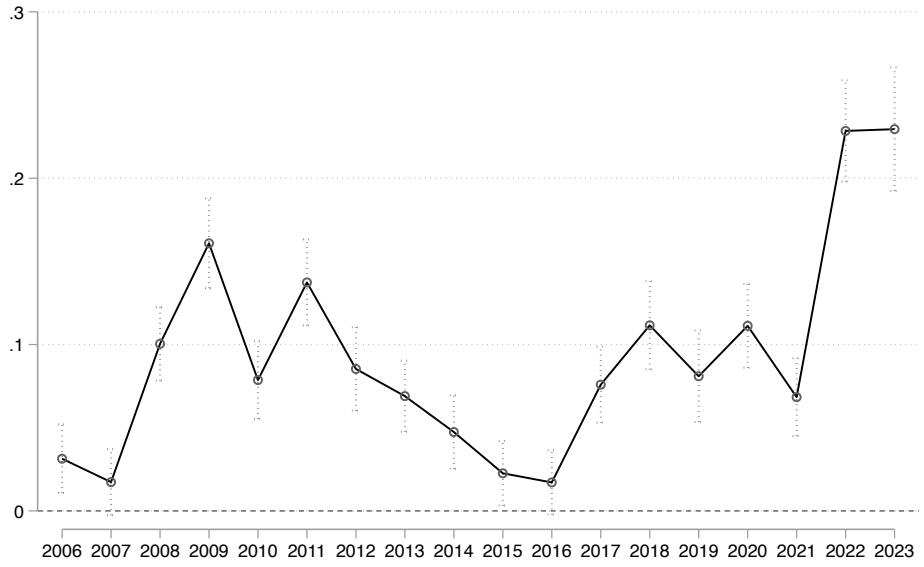
Panel A: Year Fixed Effects



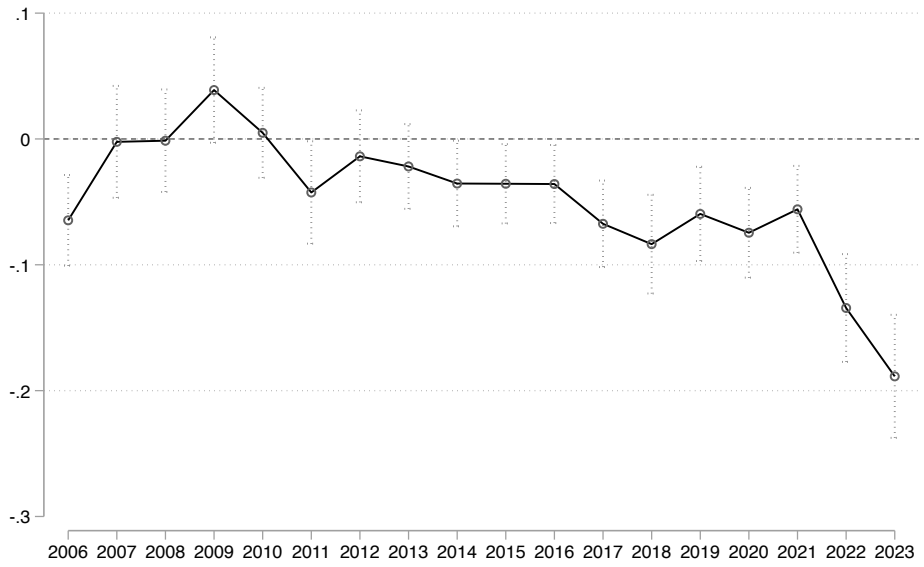
Panel B: National x Year Fixed Effects

Figure 5: Regression Analysis of Underwriting Spreads Over Time

The figure shows the average underwriting spreads over time after controlling for determinants of spreads using the regression model in Equation (3). Panel A plots the Year fixed effects. Panel B plots the National x Year fixed effects. Spreads are dollar amounts per $100 of issuance. Underwriters are classified based on how many states they underwrite in a given year. National underwriters are those that do business in 40 or more states in a given year. Data sources: Mergent municipal fixed income database, SDC Platinum, and Bloomberg. Sample period: 2005–2023.



Panel A: Year Fixed Effects



Panel B: National x Year Fixed Effects

Figure 6: Probability of Uninformed Trade

The figure plots the mean probability of uninformed trades by subperiod and their standard errors, based on the classification regression of the mixture model with informed and uninformed investors. Estimates are based on all trades within 14 days of the offering date or until the bond size is fully absorbed, whichever earlier. The model is estimated separately for non-overlapping two-year periods beginning in 2006. Data sources: Mergent municipal fixed income database, MSRB trade data, SDC Platinum and Bloomberg. Sample period: 2005–2023.

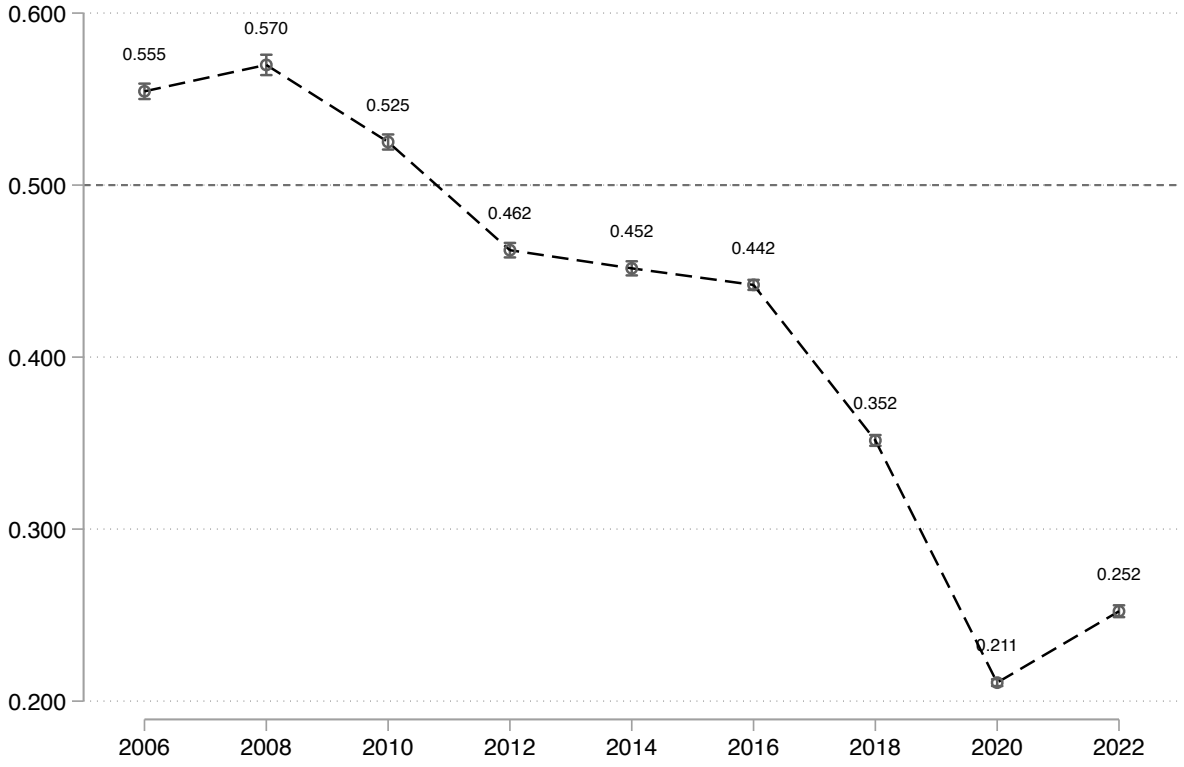


Figure 7: Markups on Uninformed Trades

The figure plots the mean markups (in percentage points) on uninformed trades and their standard errors, based on the outcome regression of the mixture model with informed and uninformed investors. Estimates are based on all trades within 14 days of the offering date or until the bond size is fully absorbed, whichever earlier. The model is estimated separately for non-overlapping two-year periods beginning in 2006. Data sources: Mergent municipal fixed income database, MSRB trade data, SDC Platinum and Bloomberg. Sample period: 2005–2023.

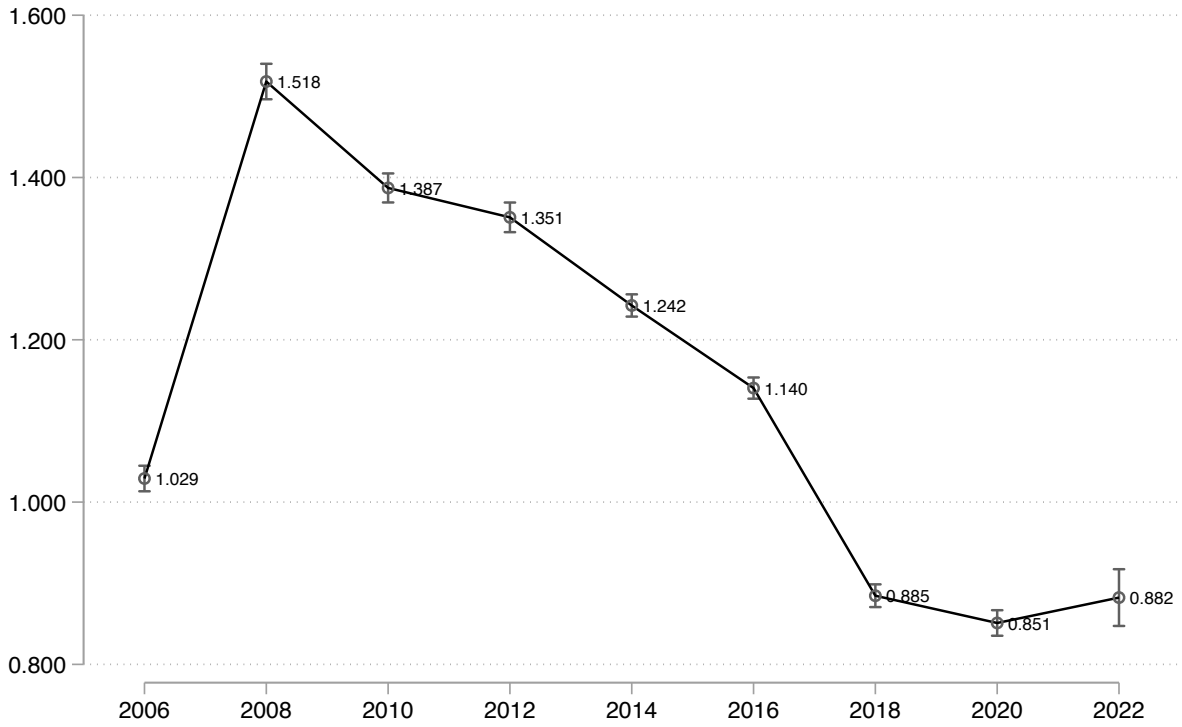


Figure 8: Effects of National Underwriter on the Probability of Uninformed Trades

The figure plots the effects of the National Underwriter dummy variable on the probability of a trade with uninformed investors. The estimate is from the classification regression of the mixture model with informed and uninformed investors. National underwriters are those that underwrite bonds in 40 or more states in a given year. Estimates are based on all trades within 14 days of the offering date or until the bond size is fully absorbed, whichever earlier. The model is estimated separately for non-overlapping two-year periods beginning in 2006. Data sources: Mergent municipal fixed income database, MSRB trade data, SDC Platinum and Bloomberg. Sample period: 2005–2023.

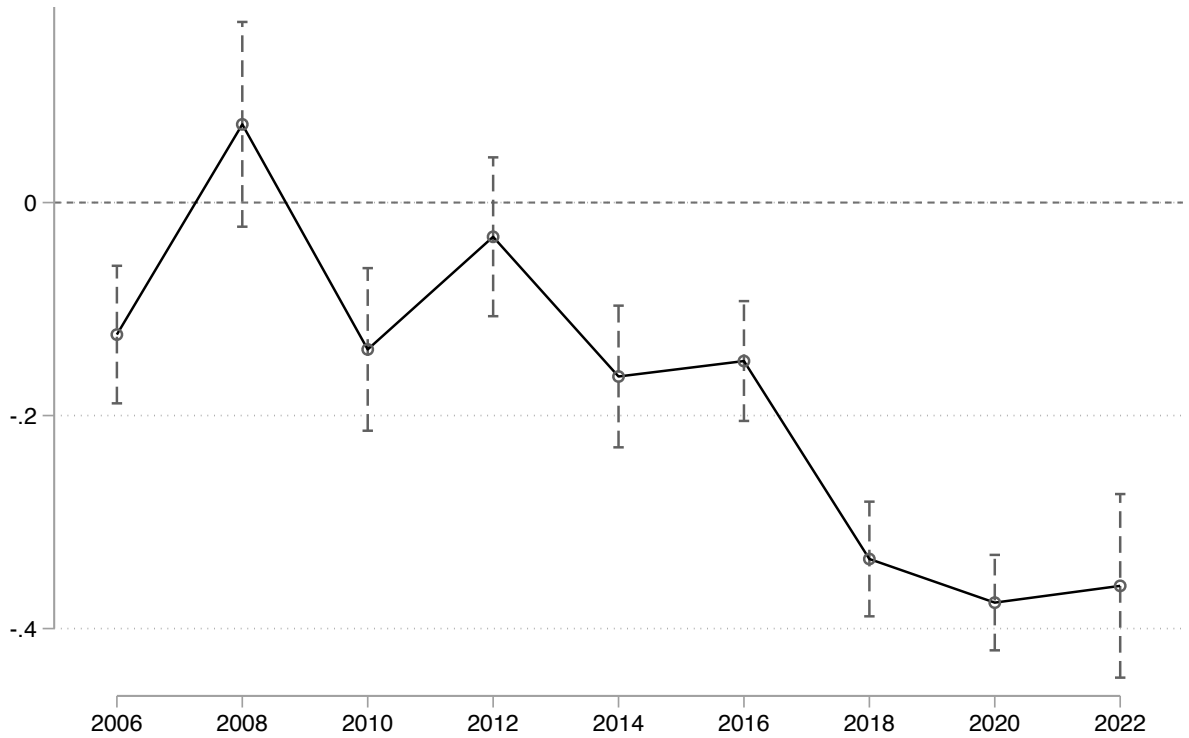


Figure 9: Effects of National Underwriter on the Markups on Uninformed Trades

The figure plots the coefficient of the National Underwriter dummy in the markup outcome equation in the uninformed regime. National underwriters are those that underwrite bonds in 40 or more states in a given year. Markups are expressed in percentage points. Estimates are based on all trades within 14 days of the offering date or until the bond size is fully absorbed, whichever earlier. The model is estimated separately for non-overlapping two-year periods beginning in 2006. Data sources: Mergent municipal fixed income database, MSRB trade data, SDC Platinum and Bloomberg. Sample period: 2005–2023.

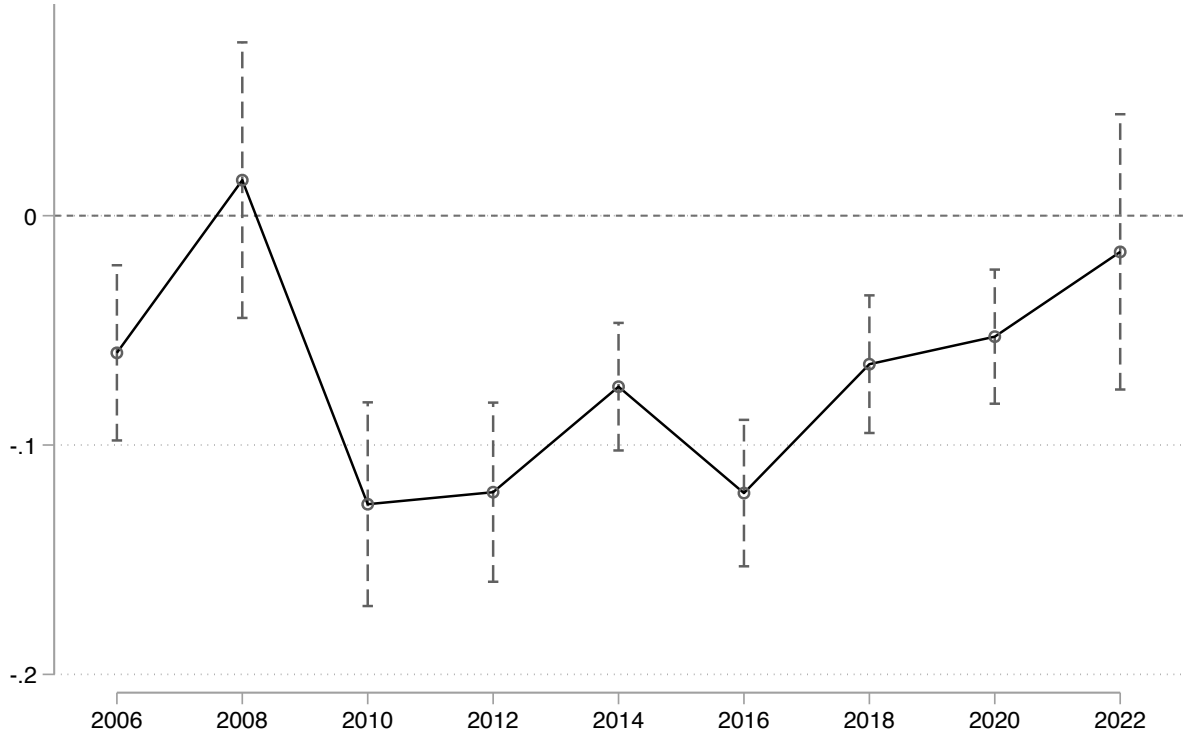


Figure 10: Effects of Underwriter Spreads on the Probability of Uninformed Trades

The figure plots the coefficient of the underwriting spread on the probability of a trade with uninformed investors. The estimate is from the classification regression of the mixture model with informed and uninformed investors. Estimates are based on all trades within 14 days of the offering date or until the bond size is fully absorbed, whichever earlier. The model is estimated separately for non-overlapping two-year periods beginning in 2006. Data sources: Mergent municipal fixed income database, MSRB trade data, SDC Platinum and Bloomberg. Sample period: 2005–2023.

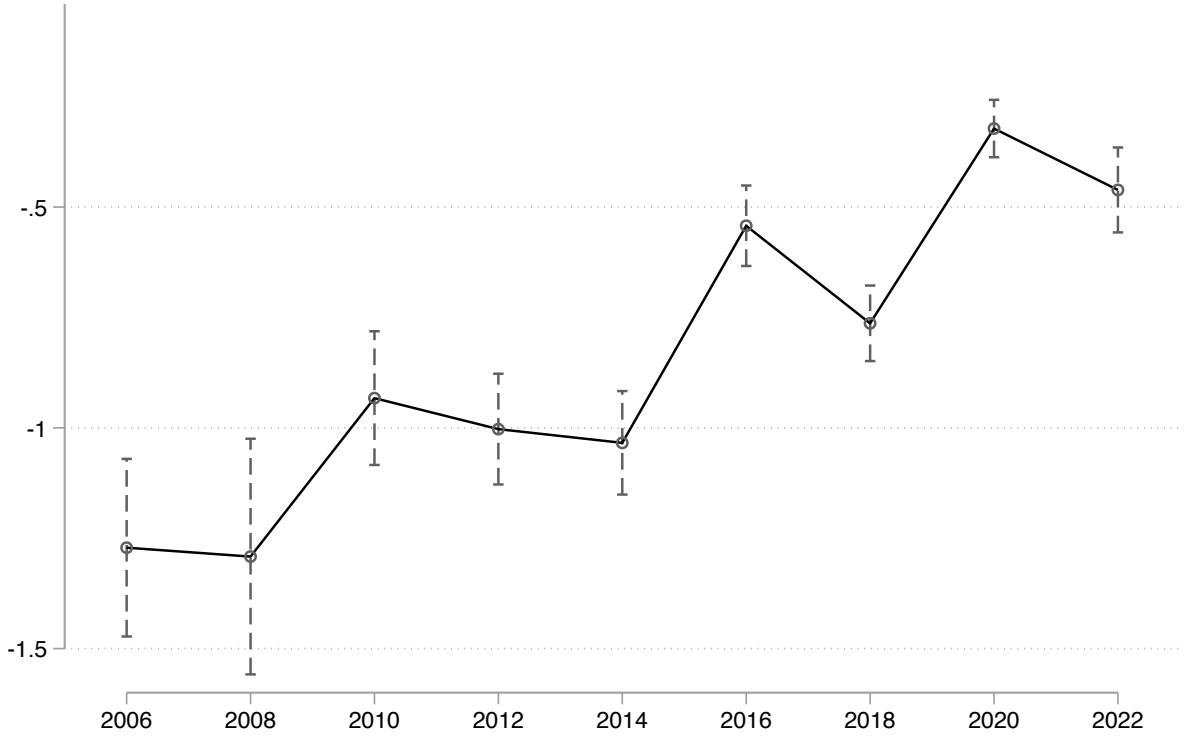
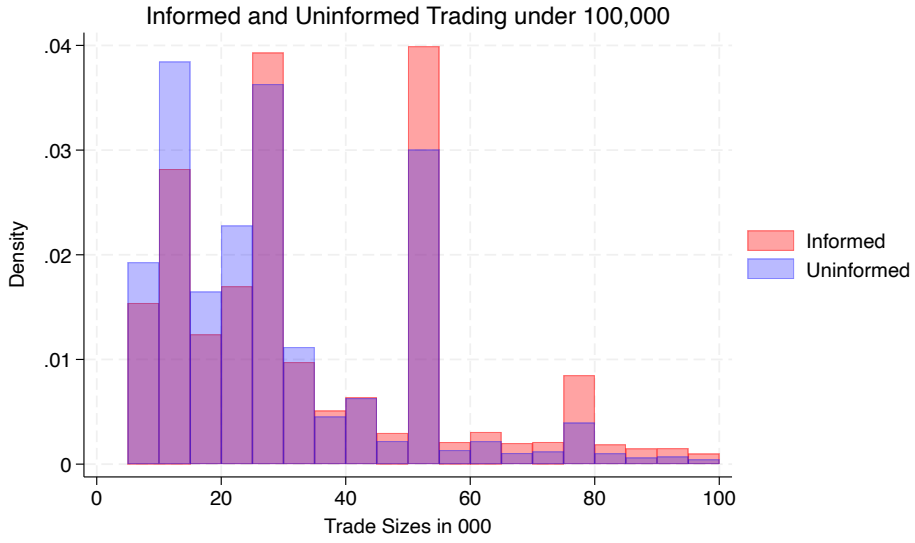
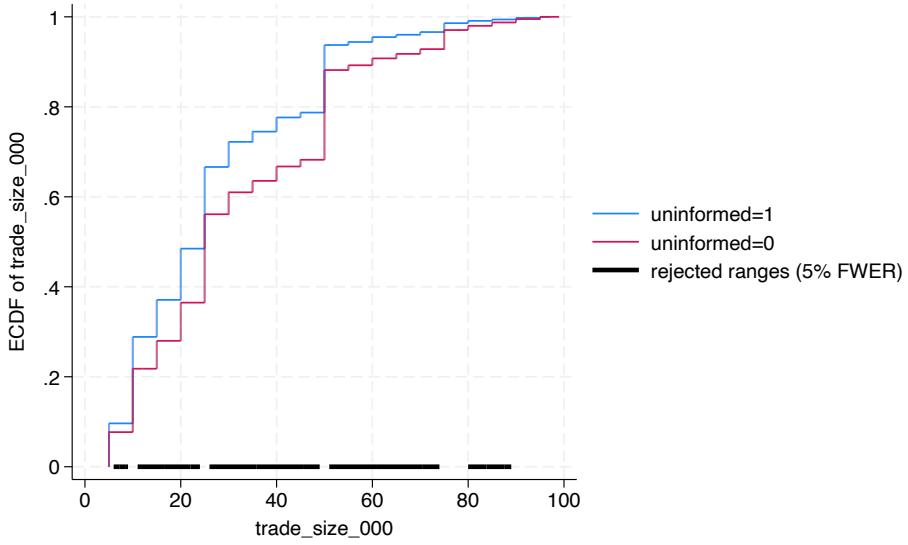


Figure 11: Relative Distributions of Uninformed/Informed Trades

The figure plots two versions of the distributional overlap between uninformed and informed trades below 100,000. Uninformed and informed trades are defined as the posterior probabilities generated from the structural model in Section 5. Panel A plots histograms for each distribution using bins of width 5,000. Panel B implements the point-by-point multiple testing of the CDFs as in Goldman and Kaplan (2018), with regions where equality can be rejected highlighted by the bold black line on the x-axis. Sample period: 2005–2023.



Panel A: Overlapping Histograms, Trades below 100k



Panel B: Point by Point Comparison, Trades below 100k

A Online Appendix

Figure A.1: Composition of Underwriters (By State)

Figure shows the fraction of each underwriter type in an average year for each given state. Underwriters are classified based on how many states they underwrite in a given year: "single state" if one state, "small regional" if between 2 and 19 states, "large regional" if between 20 and 39, and "national" if 40 and above. Data source: Mergent municipal fixed income database. Sample period: 2005–2023.

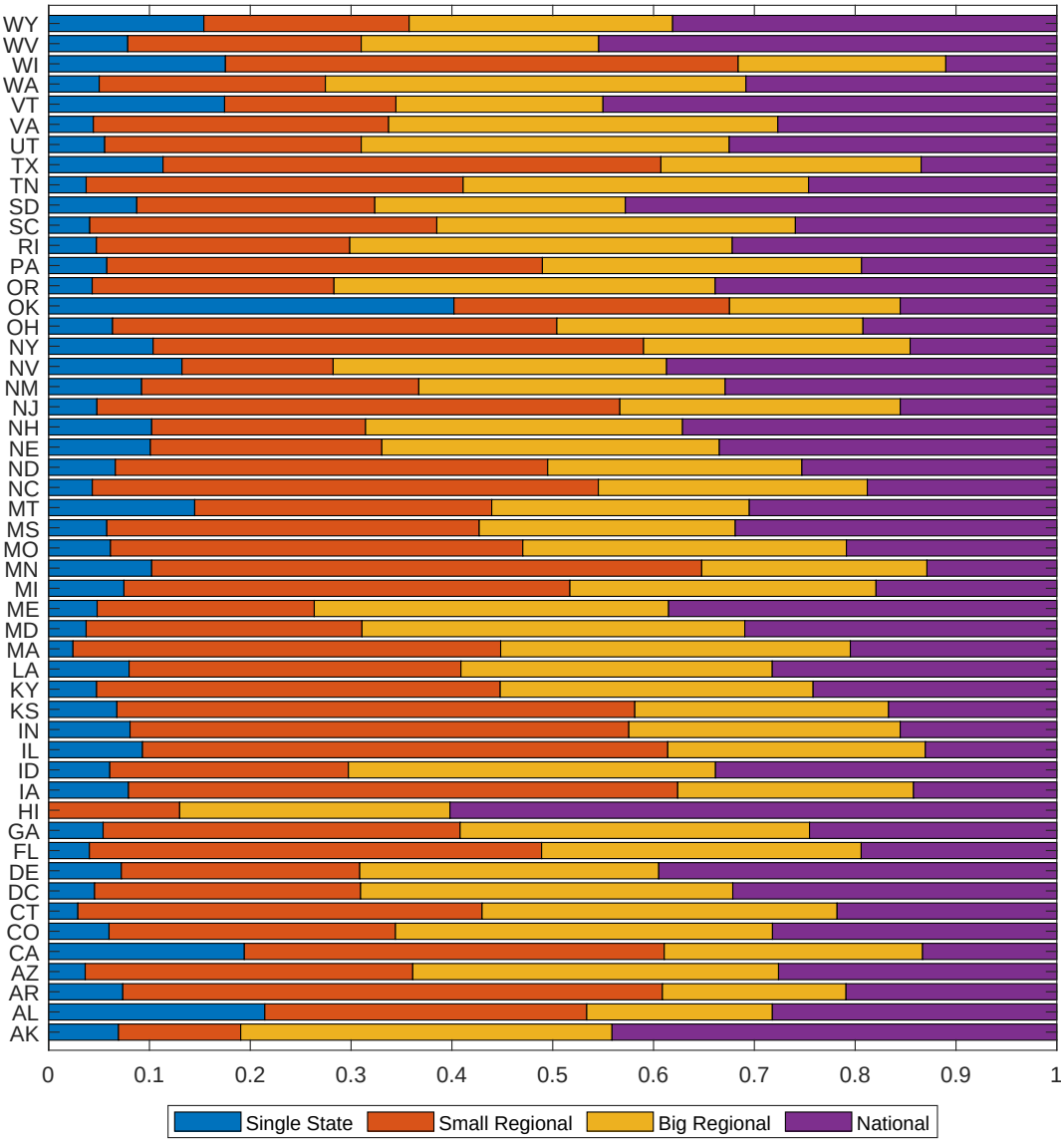


Figure A.2: Fraction of Deals (By Underwriter Type and State)

Figure shows the fraction of deals underwritten by each underwriter type in an average year for each given state. Underwriters are classified based on how many states they underwrite in a given year: "single state" if one state, "small regional" if between 2 and 19 states, "large regional" if between 20 and 39, and "national" if 40 and above. Data source: Mergent municipal fixed income database. Sample period: 2005–2023.

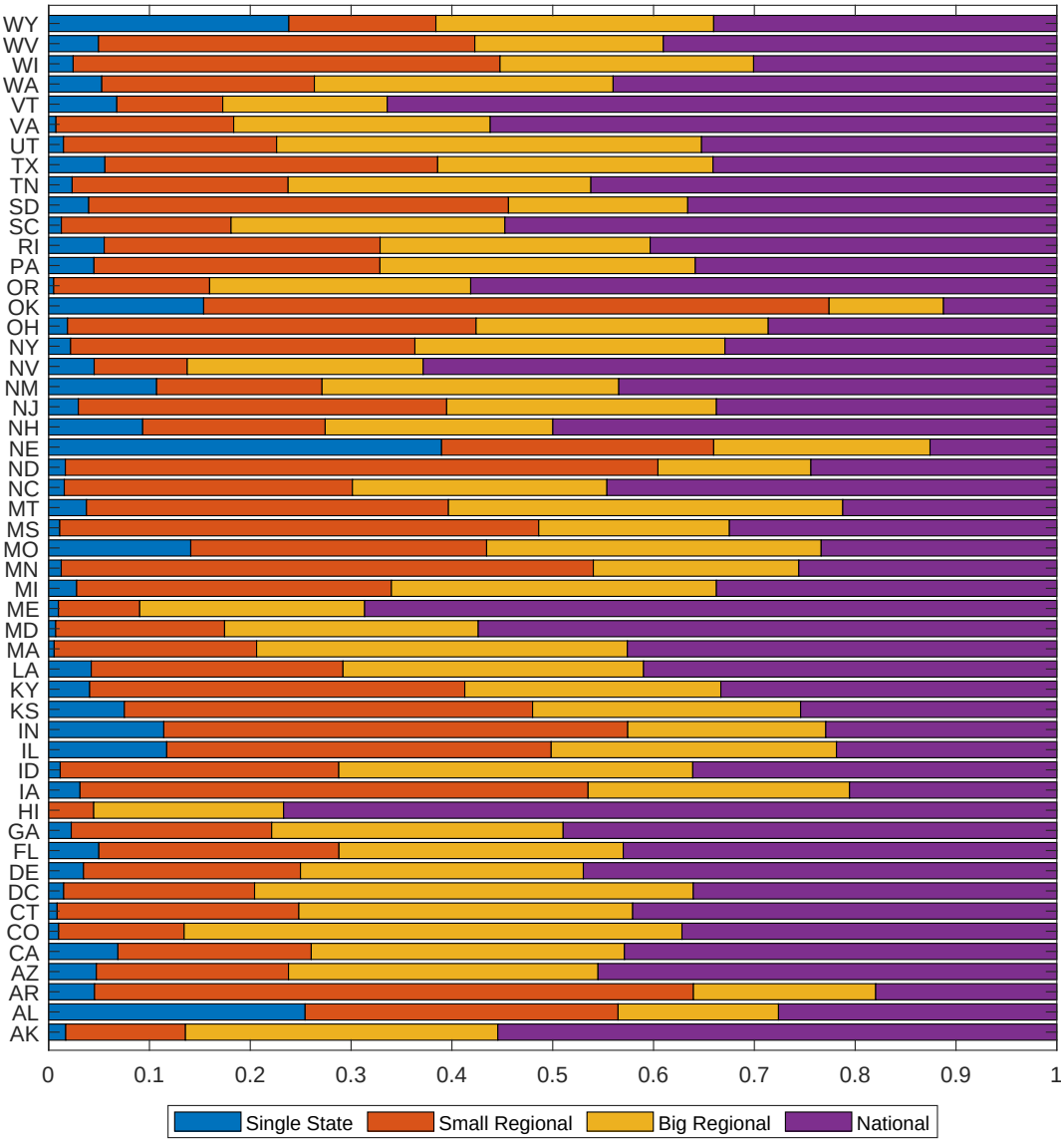


Figure A.3: Fraction of Volume (By Underwriter Type and State)

Figure shows the fraction of volume underwritten by each underwriter type in an average year for each given state. Underwriters are classified based on how many states they underwrite in a given year: "single state" if one state, "small regional" if between 2 and 19 states, "large regional" if between 20 and 39, and "national" if 40 and above. Data source: Mergent municipal fixed income database. Sample period: 2005–2023.

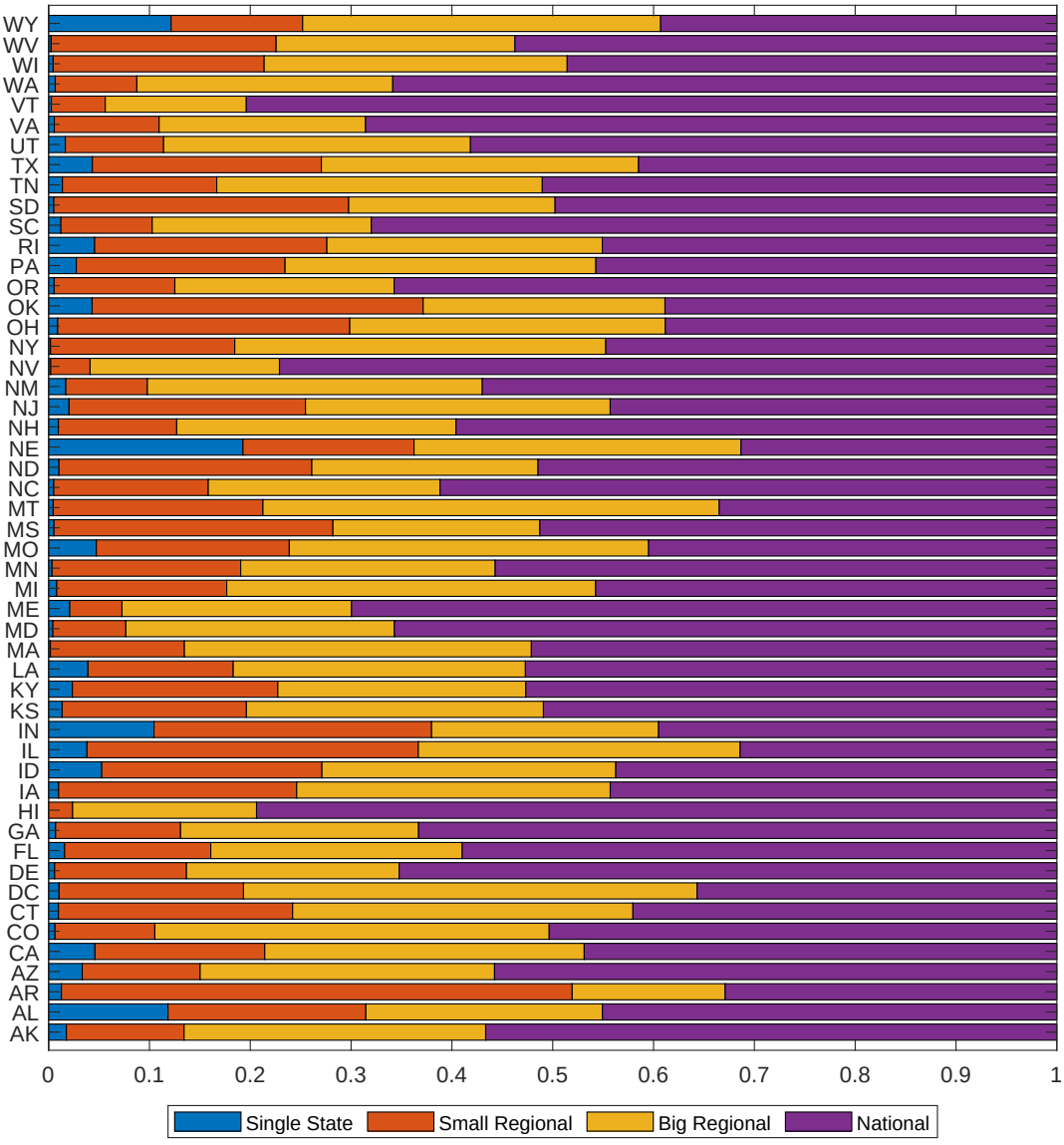


Figure A.4: Unconditional Distribution of New Issue Markups

The figure shows the dispersion of markups on trades in the new issue market (i.e., within 14 days of offering) by bond issue year cohort and trade size category. For each bond on each day, markups on trades of a given trade size category are centered on the average markup of such trades in the bond within the day. N indicates the number of trades underlying the corresponding histogram. Bond issue data is from the Mergent municipal fixed income database. Bond trade data is from the MSRB. The sample period is from 2005 to 2023.

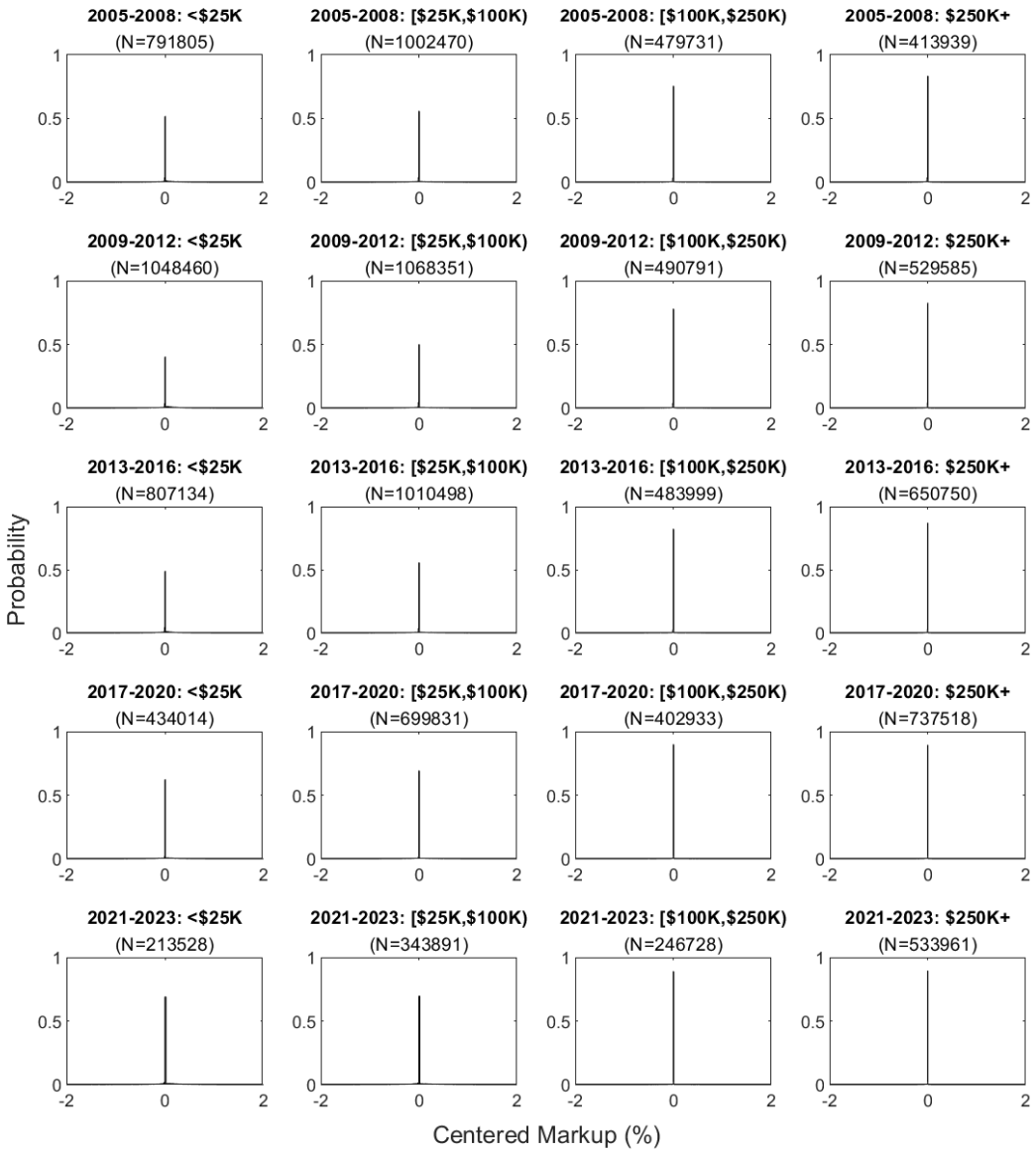


Figure A.5: Distribution of New Issue Markups (Excluding Bond-Days With No Dispersion)

The figure shows the dispersion of markups on trades in the new issue market (i.e., within 14 days of offering) by bond issue year cohort and trade size category, excluding bond-days with no price dispersion. For each bond on each day, markups on trades of a given trade size category are centered on the average markup of such trades in the bond within the day. N indicates the number of trades underlying the corresponding histogram. Bond issue data is from the Mergent municipal fixed income database. Bond trade data is from the MSRB. The sample period is from 2005 to 2023.

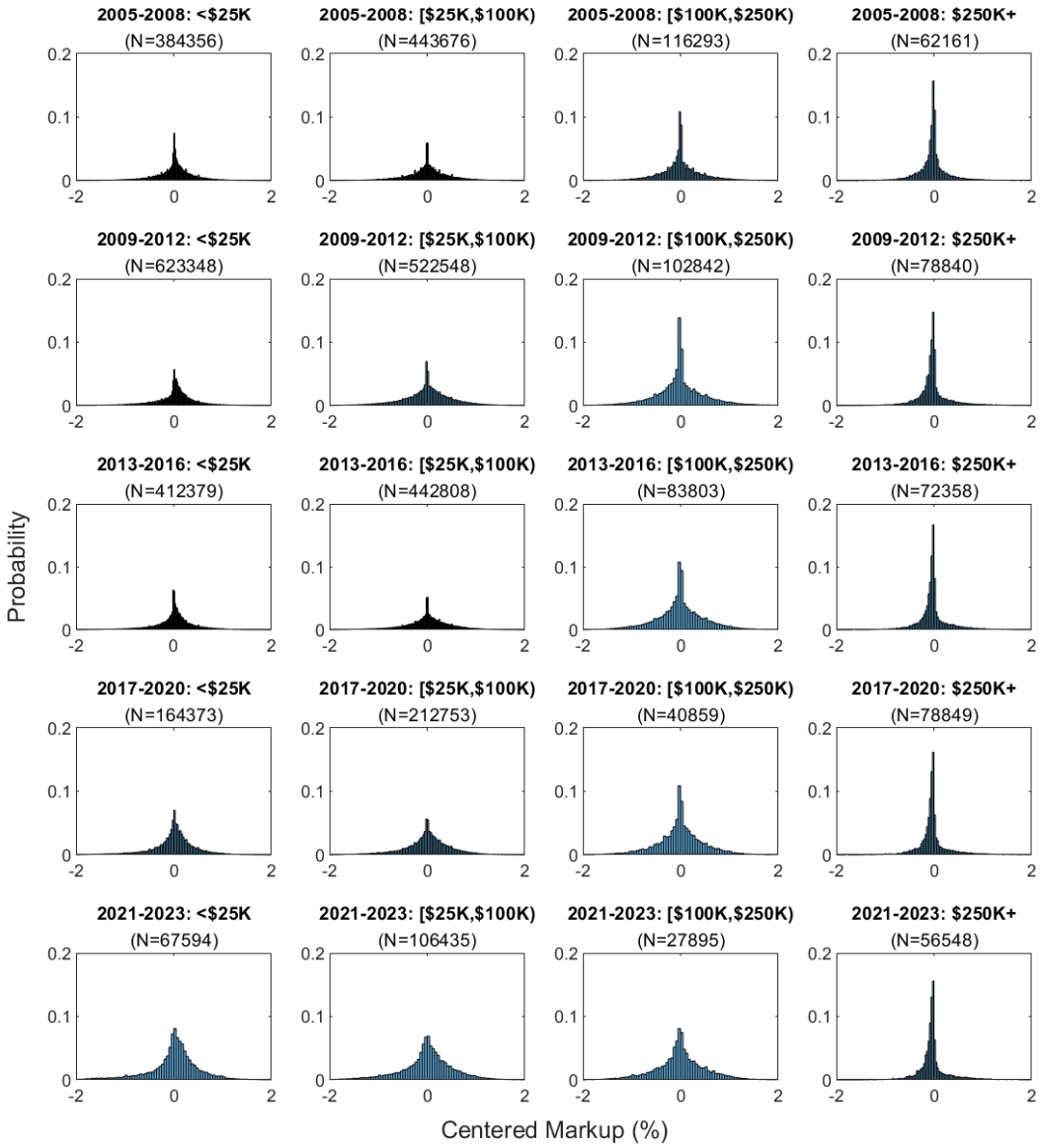


Figure A.6: Fraction of Trades on Days with Markup Dispersion

The figure shows the percent of new-issue trades occurring on bond-days with markup dispersion among trades of the same size category in the same bond on the same day. New-issue trades are those that occur within 14 days of bond issuance. Bond issue data is from the Mergent municipal fixed income database. Bond trade data is from the MSRB. The sample period is from 2005 to 2023.

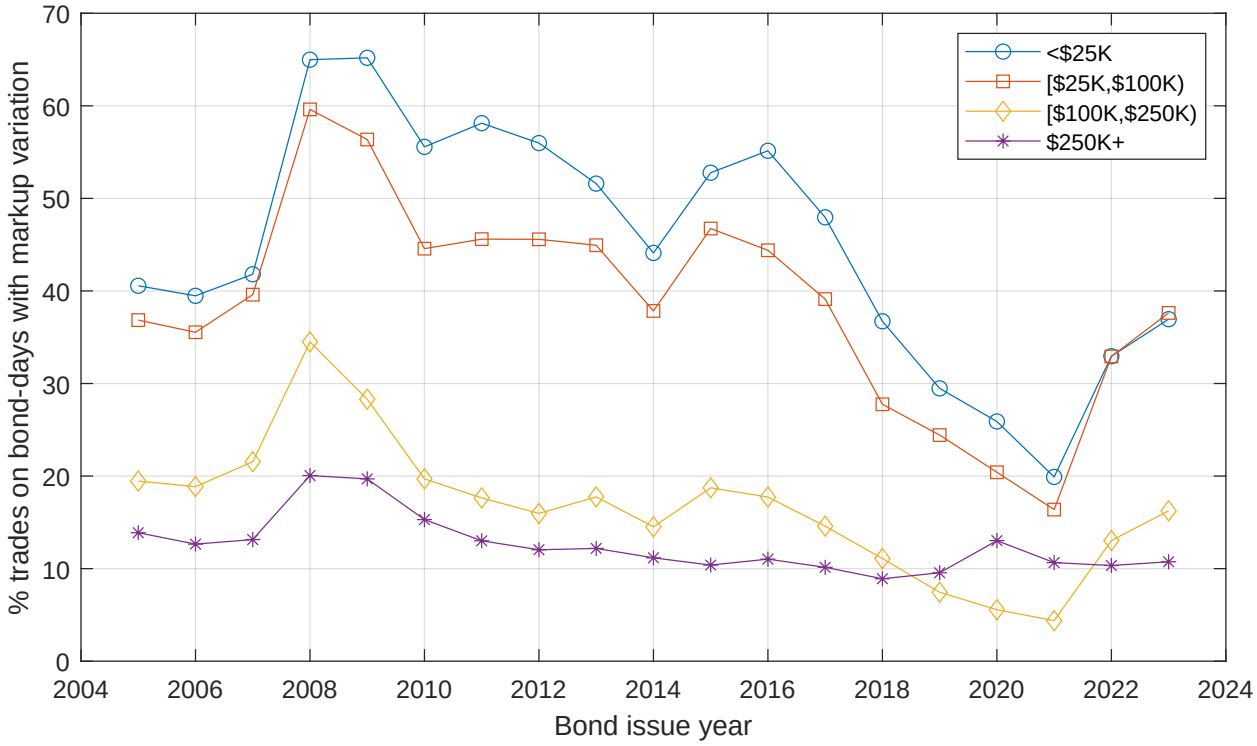


Figure A.7: Coefficients on National Underwriter x Year Interaction: Markup, GO bonds

The figure plots the coefficients from the interaction between National underwriter classification and year from the regression in Equation 2 restricted to only GO bonds. Underwriters are classified based on how many states they underwrite in a given year: "single state" if one state, "small regional" if between 2 and 19 states, "large regional" if between 20 and 39, and "national" if 40 and above. Data source: Mergent municipal fixed income database and MSRB trade data. Sample period: 2005–2023.

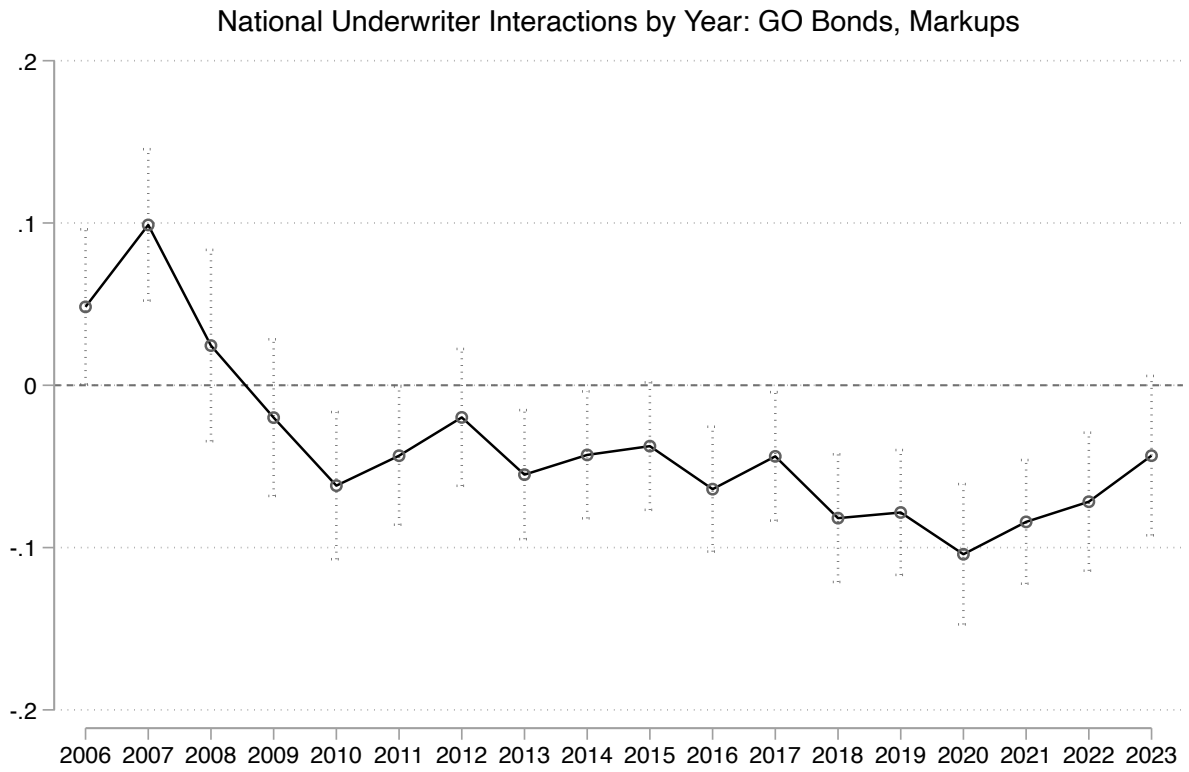


Figure A.8: Coefficients on National Underwriter x Year Interaction: Percent Spread, GO bonds

The figure plots the coefficients from the interaction between underwriter classification and year from the regression in Equation 2 modified to the issue level (bond amount not included) and restricted to GO bonds. Underwriters are classified based on how many states they underwrite in a given year: "single state" if one state, "small regional" if between 2 and 19 states, "large regional" if between 20 and 39, and "national" if 40 and above. The base category is all other regional (not national) underwriters by year. Spreads are dollar amounts per $100 from both SDC Platinum and Bloomberg. Data source: Mergent municipal fixed income database and MSRB trade data. Sample period: 2005–2023.

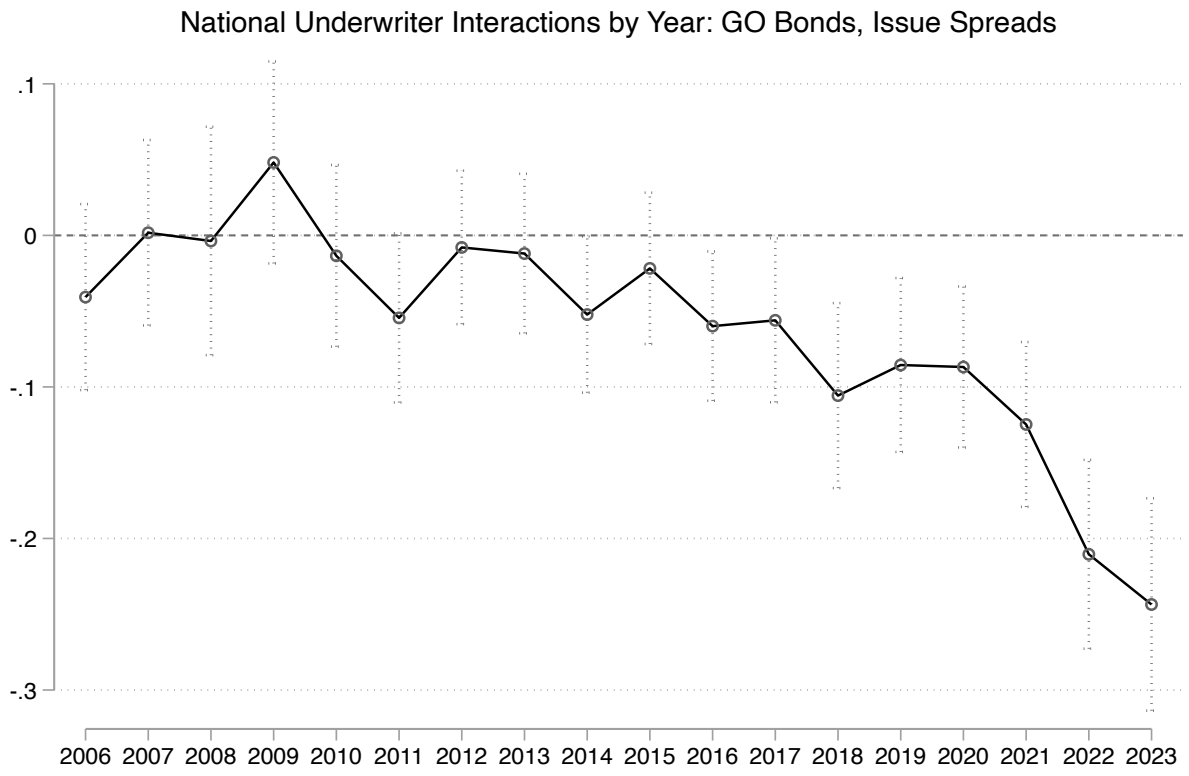


Figure A.9: Probability of Informed Trade: Revenue Bonds

The figure plots the latent class mean probablity and their standard errors from the mixture model with two latent classes. Estimates are for all trades from [-1 to 14 days] in rated Revenue bonds in two year periods beginning in 2006. Data sources: Mergent municipal fixed income database and MSRB trade data, SDC Platinum and Bloomberg. Sample period: 2005–2023.

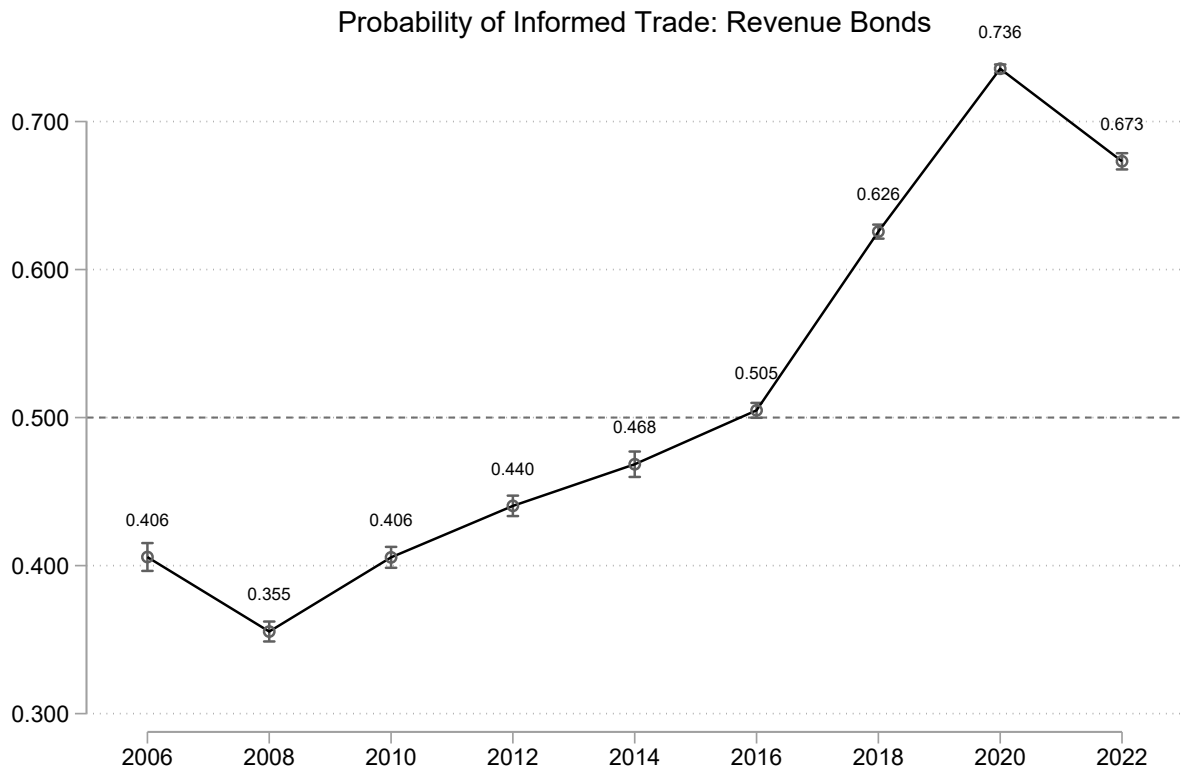


Figure A.10: Markup of Trades, Conditional on Uninformed Type: Revenue Bonds

The figure plots the latent class mean markups and their standard errors from the mixture model with two latent classes for uninformed trader types. Markups for informed traders are effectively zero for all periods. Estimates are for all trades from [-1 to 14 days] in rated Revenue bonds in two year periods beginning in 2006. Data sources: Mergent municipal fixed income database and MSRB trade data, SDC Platinum and Bloomberg. Sample period: 2005–2023.

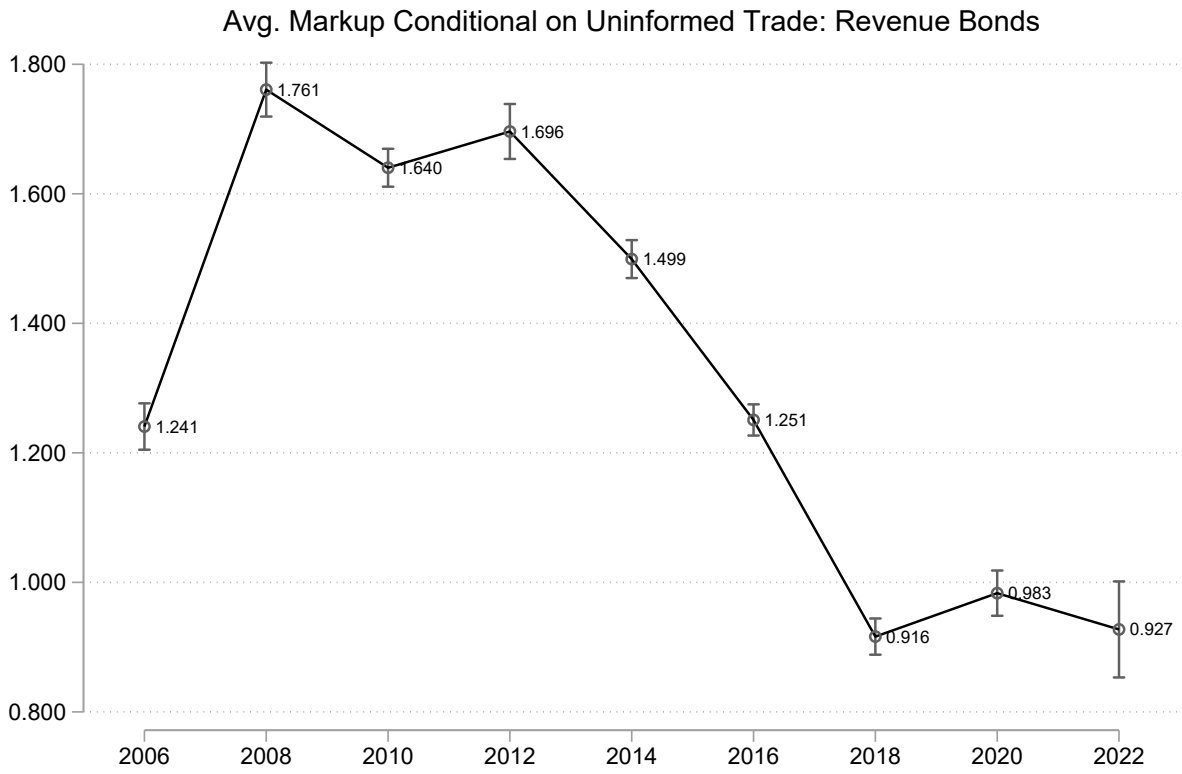


Figure A.11: Probability of Informed Trade: All Bonds Until Absorbed

The figure plots the latent class mean probablity and their standard errors from the mixture model with two latent classes. Estimates are for trades in the window from [-1 to 14 days] or until the par amount of the bond is sold to customers, whichever is shorter for rated bonds in two year periods beginning in 2006. Data sources: Mergent municipal fixed income database and MSRB trade data, SDC Platinum and Bloomberg. Sample period: 2005–2023.

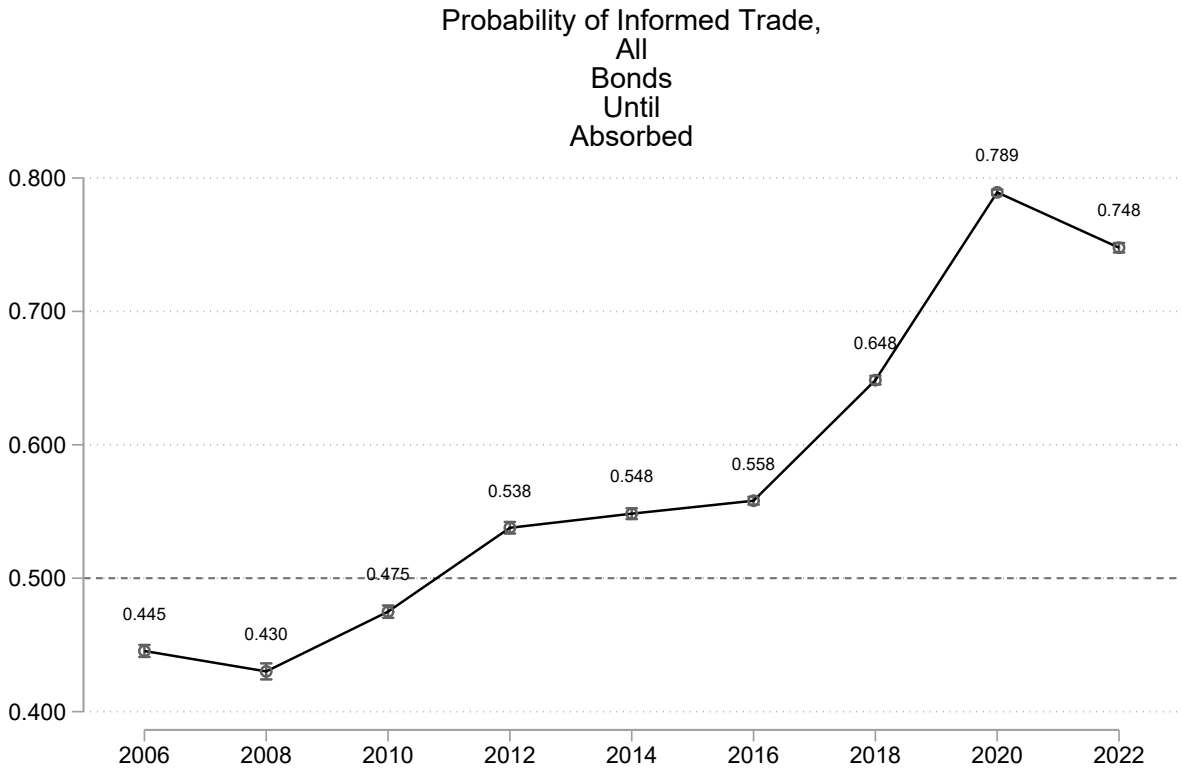


Figure A.12: Markup of Trades, Conditional on Uninformed Type: All Bonds Until Absorbed Bonds

The figure plots the latent class mean markups and their standard errors from the mixture model with two latent classes for uninformed trader types. Markups for informed traders are effectively zero for all periods. Estimates are for trades in the window from [-1 to 14 days] or until the par amount of the bond is sold to customers, whichever is shorter for rated bonds in two year periods beginning in 2006. Data sources: Mergent municipal fixed income database and MSRB trade data, SDC Platinum and Bloomberg. Sample period: 2005–2023.

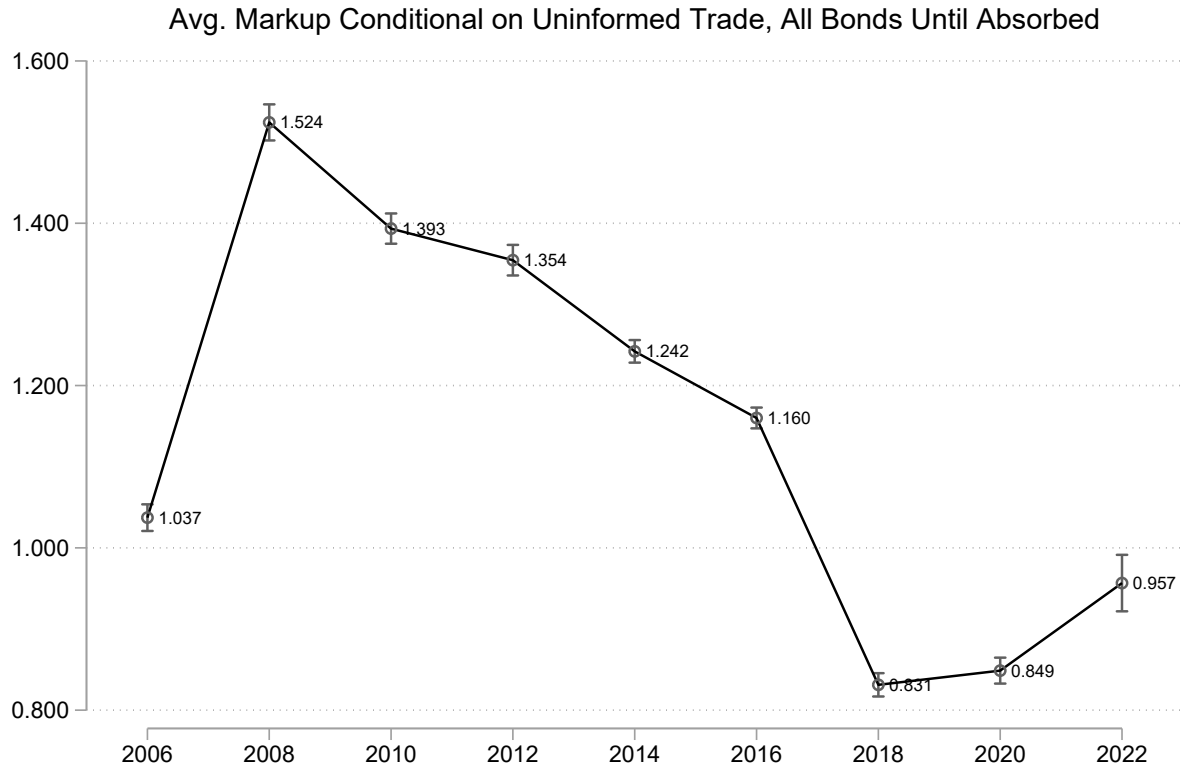


Figure A.13: Underwriter Spreads in Classification: Uninformed Trades

The figure plots coefficient on the underwriting spread in the classification equation on the probability of a trade with an uninformed investor. Estimates are for all trades from [-1 to 14 days] in rated GO bonds in two year periods beginning in 2006. Data sources: Mergent municipal fixed income database and MSRB trade data, SDC Platinum and Bloomberg. Sample period: 2005–2023.

