Informed Investors and Underpricing in Municipal Bond Offerings*

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Abstract

This paper studies the effect of local mutual funds on municipal bond issuance. Offering yields are higher in states where municipal bond funds' headquarters are located, and in states with larger aggregate fund size. However, holding local fund size constant, yields decrease in the number of funds. Such relations hold when local funds' primary market participation is instrumented with the characteristic differences between the new issues and existing bonds in local funds' portfolios. A security underpricing model that incorporates imperfectly informed investors confirms my empirical findings.

JEL classification: G12, G14, G23

Keywords: municipal bonds, IPOs, mutual funds, OTC markets, information asymmetry

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1 Introduction

Information asymmetry is one of the fundamental problems in finance and economic research. In particular, it has been shown to be one determinant of the widely documented underpricing in initial public offerings (IPOs), both theoretically (Rock, 1986) and empirically (e.g., Beatty and Ritter, 1986; Michaely and Shaw, 1994; Aggarwal, Prabhala, and Puri, 2002). However, previous empirical analyses only either proxy for informed investors' investments or examine them in the aggregate. In this paper, I contribute to the literature by demonstrating how the composition of investors, not only between informed versus uninformed but also among the informed, affects the pricing of municipal bond (muni) issues. The muni market provides a perfect laboratory setting for such an analysis due to its information asymmetry, as well as the possibility to identify potential informed investors—local mutual funds—in bond offerings.

The muni bond market is characterized with high dominance of retail investors. According to the Financial Accounts of the United States,[1] households and non-profit organizations held 44.82% of the aggregate municipal market value as of 2021. Additionally, the muni market is illiquid and infrequently traded. Schwert (2017) estimates that the median Amihud illiquidity measure for municipal bonds is 3.34% per $1 million transaction, while in Dannhauser (2017), the similar measure for corporate bonds is 0.20%. Likewise, between 2009 and 2019, 80% of outstanding muni bonds do not trade in any given month in the secondary market. These facts, combined with the popularity of retail investors, suggest a high level of information asymmetry in the municipal bond market.

In recent years, institutional investors, particularly mutual funds, have shown increased interest in the muni market. Since the financial crisis, open-end mutual funds' muni market share has more than doubled, steadily increasing from 12.04% in 2009 to 24.38% in 2021.

[1] https://www.federalreserve.gov/releases/z1/.

Compared to retail investors, mutual funds have higher bargaining power and more sophisticated investment skills, both of which could have significant effects on bond prices at which they transact. This is particularly the case for local funds, which are large investors with an informational advantage thanks to their proximity to the local market. Therefore, this paper investigates whether and how local muni funds—funds whose operational headquarters are in the same state as the issuer—impact the pricing of muni bonds at issuance.

In the first part of the paper, I propose a theoretical model that studies how informed investors influence security pricing in a market with asymmetric information. My model builds on the seminal IPO underpricing model by Rock (1986). In his model, the security is underpriced to compensate uninformed investors for their winner's curse—the potential loss they would incur if the offering price is higher than the security's true value and informed investors withdraw from the market. My model extends Rock (1986)'s model in two ways. First, I consider a scenario where there are several informed investors with independent (or more generally, less than perfectly correlated) information about the security's true value, instead of just one aggregate investor as in the original model. Second, I assume that informed investors are not perfectly informed. With a positive probability, they no longer receive any signal and therefore, they make the same decision as the uninformed investors.

With the assumptions outlined above, my theoretical model generates two key implications. First, in line with Rock (1986), the equilibrium offering price (underpricing) decreases (increases) in informed investors' share of the aggregate capital available in the offering. The second implication is a new contribution. Holding the capital share of informed investors constant, the offering price increases in the number of informed investors. That means the offering price drops when there is one informed investor versus when all investors are uninformed, but then gradually rises as the number of informed investors further increases. This V-shaped relation arises because informed investors have independent information, leading to the ex-post availability of capital from truly informed investors being lower than the aggregate capital of potentially informed investors ex-ante.

These theoretical implications yield two testable hypotheses for my empirical study of municipal bond offerings. First, bond offering yields are higher in states with local funds and when their aggregate fund size is larger. Second, conditional on the presence of local funds and holding their size constant, offering yields decrease in the number of funds in the local market.

Examining open-end municipal bond mutual funds whose headquarters are located in the same state as the bond issuer, I document strong evidence supporting the hypotheses outlined above. Specifically, I find that yield spreads are higher in states with at least one muni fund, with an estimated difference of 6.6 basis points (bps), accounting for 17% of the sample mean or 11% of the sample standard deviation.[2] Similarly, bond yield spreads increase by 1.8 bps for every two-fold increase in the aggregate size of local funds. These results align with the information asymmetry channel but not with the demand channel, with the latter suggesting that higher demand from local funds would result in lower bond yield spreads.

The second hypothesis is supported by the finding that, conditional on having the same aggregate fund size, yield spreads are lower when there are more local funds, or equivalently, when local fund capital is less concentrated. I obtain similar results when examining fund families instead of individual funds and when using a different definition of local funds. This definition considers all U.S. municipal bond funds with characteristics, such as fund size, being adjusted by the distance between their headquarters and the bond's county.

Examining local funds may not perfectly resemble the model as they may not be potential buyers of the new issues, for example, due to budget constraints. To address this issue, I

[2] Given the limited municipal bond trading activity, I use yield spread as a proxy for underpricing. A higher yield spread indicates that the bond is relatively more underpriced compared to other similar bonds issued in the same county and at the same time.

utilize the bond holdings of local funds, reported within three months from the issuance date, as a proxy for their interest in the initial offering. There are yet concerns associated with the use of actual holdings in studying the relation between local funds' primary market participation and bond pricing. For instance, local funds may not immediately purchase the bond during the offering but may do so subsequently after observing other investors' trades or changes in local market conditions.[3]

To fully address potential endogeneity concerns, I employ an instrumental variables (IV) analysis. The instruments need to affect local funds' propensity to purchase the new bonds, and subsequently impact bond yield spreads only through that channel. Following Koijen and Yogo (2019) and Bretscher et al. (2020), I exploit mutual funds' investment objectives and mandates, which restrict them to invest in assets with certain characteristics. As few funds disclose such policies in detail, I use actual holdings to measure a fund's target bond characteristics. My instruments are then the characteristic differences, in absolute terms, between the new issue and existing bonds held by local funds before the issuance. These characteristic-distance variables are used to instrument for local funds' reported holdings—a proxy for their primary market participation—in explaining bond yield spreads.

My instruments pass the *relevance* criterion since funds are more likely to purchase bonds that match their investment mandates, which is empirically confirmed by my first-stage results. The *exclusion restriction* criterion is also likely to be satisfied, as bond characteristics themselves are included in the regressions, meaning that the characteristic-deviated instruments only capture how relevant a new bond is to its potential buyers.[4]

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[3] Another potential concern is that mutual funds may choose riskier states for their headquarters, as they have more access to risky bonds. This is unlikely to be the case in this setting, since my specifications include county fixed effects and an array of control variables.

[4] One might be concerned that issuers with high ex-ante financing costs may manipulate the characteristics of their bond issues to resemble the target bond characteristics of local funds, aiming to attract more interest and thus reduce their costs of financing. If anything, this would suggest that the instrumental variables model underestimates the impact of local funds (i.e., informed investors) on bond yields in the opposite direction.

My second-stage IV analysis shows that a bond's yield spread at issuance is significantly higher by 27 basis points when at least one local fund holds the bond within three months after the offering date. This estimate, which represents the local average treatment effect, is substantially larger than the baseline estimate of 6.6 bps. The reason for this difference is that the baseline result only considers the association between bond yield spreads and local funds, without confirming whether these funds are actually interested in buying bonds in the primary market. Additionally, I provide supportive evidence for the second hypothesis: conditional on having at least one local fund investing in the bond, its offering yield spread decreases as the number of local funds holding the bond increases.

Having established a relation between local funds and bond pricing, in order to fully support the information asymmetry channel, I show that local funds are more informed than other investor types. By examining bonds with the same rating and being held by the same fund at the same time, I demonstrate that local, same-state bonds are significantly more (less) likely to experience a rating upgrade (downgrade) in the next six months than non-local bonds. This suggests that local funds possess an informational advantage in evaluating the quality of local bonds, or the likelihood of their rating changes, compared to non-local funds. In addition, I formally establish the link between local funds' informational advantage, proxied by their abnormal performance, and bond yield spreads. These results provide further support for the information asymmetry explanation, as opposed to the alternative explanation that local funds, given their bargaining power, demand higher yields in the primary market of muni bonds.

The last part of my paper provides several tests to verify the robustness of the main results. First, I provide evidence that the main results remain consistent when controlling for variations in tax-privileged policies across states (Babina et al., 2021), or when adjusting yield spreads for federal and income taxes. Second, I show that the relation between the existence of local funds (or their aggregate size) and bond yields is stronger (more positive) for smaller counties, during stressed markets, and for bonds associated with higher uncertainty. Last, to ensure that my findings are not susceptible to sample selection bias that some issuers may choose not to issue bonds, I re-estimate using Heckman (1979)'s two-way model and find that baseline results are quantitatively unchanged.

This paper contributes to several strands of literature. First, it adds to the active literature that studies investment decisions by local investors, including retail investors (Ivković and Weisbenner, 2005), mutual fund managers (Pool, Stoffman, and Yonker, 2012), and institutional investors more generally (Coval and Moskowitz, 1999, 2001; Chan, Covrig, and Ng, 2005; Baik, Kang, and Kim, 2010; Ke, Ng, and Wang, 2010; Giannetti and Laeven, 2015). My paper is however the first to study such topics in the municipal bond market, where the majority of investors are local due to tax benefits. Moreover, the muni market is populated with retail investors, who likely lack information and have low bargaining power. This highlights the importance of understanding the interaction between issuers and local investors, particularly in highly illiquid and segmented markets.

The paper also contributes to the large literature on underpricing in security offerings. The literature mostly focuses on equity markets, providing several explanations for the IPO underpricing, including information asymmetry (Rock, 1986; Beatty and Ritter, 1986; Michaely and Shaw, 1994), bookbuilding (Benveniste and Spindt, 1989; Benveniste and Wilhelm, 1990), signaling (Allen and Faulhaber, 1989; Grinblatt and Hwang, 1989; Welch, 1989), information cascade (Welch, 1992), and liquidity (Ellul and Pagano, 2006). There have been a few papers that study underpricing in the corporate bond market, such as Cai, Helwege, and Warga (2007) and Rischen and Theissen (2020). Meanwhile, muni bond offerings have been largely overlooked, with the exception of Green, Hollifield, and Schürhoff (2007), who document that muni bonds' transaction prices steadily rise over several days after issuance. By establishing a theoretical framework of asymmetric information and empirically testing its implications, I document the impact of informed investors, *local mutual funds*, on bond pricing. My findings demonstrate that the effect of informed investors on municipal bond pricing is not only significant in the aggregate but also determined by individual informed investors. This is particularly important for the municipal bond market since muni funds are large investors with expertise to extract rents from other market participants, including issuers and retail investors, given the market's illiquidity and opacity.

My third contribution relates to the growing literature on the municipal bond market and how local governments raise financing for their investment and spending purposes. The muni market is large and segmented with nearly one million outstanding securities totaling $4.0 trillion in 2021 (Municipal Securities Rulemaking Board, 2022). Several papers have studied different determinants of muni bond pricing in the primary market, including market power of broker-dealers (Green, Hollifield, and Schürhoff, 2007), investment bankers (Butler, 2008), corruption (Butler, Fauver, and Mortal, 2009), credit ratings (Adelino, Cunha, and Ferreira, 2017; Cornaggia, Cornaggia, and Israelsen, 2018), climate changes (Painter, 2020), and information transparency (Schultz, 2012; Gao, Lee, and Murphy, 2020; Doan, 2022). Babina et al. (2021) show that state funds' holdings, induced by tax-privileged policies that reduce the tax rate applied to income from muni bond investments, have various impacts on the underlying bonds. Adelino et al. (2022) investigate the impact of mutual fund flows—a proxy for capital supply—on municipal financing. My paper differs from Babina et al. (2021) and Adelino et al. (2022) in examining the role of information asymmetry in the context of muni bond issues, with *local* mutual funds being informed investors in the offerings.

The remainder of the paper is organized as follows. Section 2 proposes a model of informed investors and security underpricing. Section 3 summarizes the data sample and statistics. Section 4 discusses the main results of the relation between local funds and bond yield spreads. Section 5 reports robustness checks. Section 6 concludes.

2 Theoretical framework

In this section, I present a model of security offerings to establish the theoretical foundation for my empirical analyses. My model builds on the IPO underpricing model by Rock (1986), who suggests that with the existence of informed investors, the issuer sets the offering price such that uninformed investors break even in expectation. I extend Rock (1986)'s model with two new assumptions: 1) there are multiple informed investors potentially participating in the offering; and 2) "informed" investors are not perfectly informed about the security's value. These assumptions help introduce uncertainty in the realized capital of investors who possess knowledge of the security's true value.

2.1 Setting

Suppose an issuer (*municipality*) is planning to issue securities (*bonds*) to the public. There are two types of investors, 1) a mass of uninformed investors (*retail investors* and *non-local investors*) with capital U, and 2) N informed investors (*local funds*) with aggregate capital I, or I/N each. To the issuer and uninformed investors, the bond value, which is normalized, follows a uniform distribution $v \sim U[0, V]$. Informed investors know the true value of v with probability π and know only its distribution, as other participants, with probability $1 - \pi$. Their signals are independent and there is no collusion. All participants are risk neutral and cannot borrow. The issuer sets the offering price so that uninformed investors break even in expectation. It means that without informed investors, the offering price in equilibrium is set to $p_U = \frac{1}{2}V$. If the issue oversubscribed, there is pro rate rationing.[5]

To summarize, there are three stages in this model:

- $t = 0$: the issuer sets the price for the offering.

[5] As in Rock (1986), I do not introduce underwriter in this model. The implicit assumption here is the underwriter's interest perfectly aligns with that of the issuer, and their information is identical. This is to simplify the model with a focus on the composition of informed/uninformed investors in the offering.

- $t = 1$: (some) informed investors receive signals about the bond value, v.
- $t = 2$: with their information set, investors decide whether to purchase the bond at the offering price or not.

2.2 Perfectly informed investors ($\pi = 1$)

When informed investors know v with probability of one, the number of informed investors, N, does not matter and can be omitted. All informed investors only participate if $v \geq p$, with total capital of I. The expected payoff of the uninformed is:

$$\mathbb{E}[\Pi(p)] = \int_0^p (v-p)dF(v) + \frac{U}{U+I}\int_p^\infty (v-p)dF(v) \tag{1}$$

The first part of the expected payoff function corresponds to the scenario in which the offering price p exceeds the true value v. In this case, informed investors, who know v, withdraw from the offering, leaving only uninformed investors to purchase the entire issuance amount at a loss. Conversely, when the offering price p is lower than the true value v, both informed and uninformed investors purchase the bond at a profit, and the issuance amount is distributed proportionally among them.

With $v \sim U[0, V]$, solving $\mathbb{E}[\Pi(p)] = 0$ gives the solution:

$$p^* = \frac{1}{1+\sqrt{\frac{U+I}{U}}}V < p_U \tag{2}$$

This result follows Rock (1986). That is, the issuer needs to set a lower offering price to compensate uninformed investors for their winner's curse if informed ones participate. It can also be shown that p^* is declining in I relative to U, i.e., when a larger fraction of total capital is from informed investors.

2.3 Imperfectly informed investors ($\pi < 1$)

A more general case is when informed investors only knows v's true value with probability π. With probability π, they participate only if $v \geq p$. With probability $1 - \pi$, they make the same decision as uninformed ones. As an example, I provide an analysis when $N = 1$ and $N = 2$ before deriving the general solution.

2.3.1 One imperfectly informed investor

With only one informed investor, uninformed investors' expected payoff becomes:

$$\mathbb{E}[\Pi(p)] = \pi \left[\int_0^p (v-p)dF(v) + \frac{U}{U+I} \int_p^\infty (v-p)dF(v) \right] + (1-\pi)\frac{U}{U+I} \int_0^\infty (v-p)dF(v) \quad (3)$$

Requiring $\mathbb{E}[\Pi(p)] = 0$ yields:

$$\frac{U}{U+I}(V-p)^2 = \left(\frac{U+\pi I}{U+I} \right) p^2, \quad (3')$$

or

$$\hat{p}_1 = \frac{1}{1+\sqrt{\frac{U+\pi I}{U}}} V \in (p^*; p_U) \quad (4)$$

2.3.2 Two imperfectly informed investors

Each of the two informed investors, having capital $\frac{1}{2}I$ each, independently knows the true value of v with probability π. Thus, with probability π^2, both know the true value of v and with probability $(1-\pi)^2$, none does. With probability $2\pi(1-\pi)$, only one, with $\frac{1}{2}I$ capital, knows v's true value and the other only knows its distribution, meaning the realized informed and uninformed capitals are $\frac{1}{2}I$ and $U + \frac{1}{2}I$, respectively. Uninformed investors' expected payoff then becomes:

$$\mathbb{E}[\Pi(p)] = \pi^2 \left[\int_0^p (v-p)dF(v) + \frac{U}{U+I}\int_p^\infty (v-p)dF(v) \right] + (1-\pi)^2 \frac{U}{U+I}\int_0^\infty (v-p)dF(v)$$
$$+ 2\pi(1-\pi)\left[\frac{U}{U+\frac{1}{2}I}\int_0^p (v-p)dF(v) + \frac{U}{U+I}\int_p^\infty (v-p)dF(v)\right] = 0, \tag{5}$$

which, given v's uniform distribution, is equivalent to:

$$\frac{U}{U+I}(V-p)^2 = \left(\pi^2 + (1-\pi)^2 \frac{U}{U+I} + 2\pi(1-\pi)\frac{U}{U+\frac{1}{2}I}\right)p^2 \tag{5'}$$

Set $M = \pi^2 + (1-\pi)^2\frac{U}{U+I} + 2\pi(1-\pi)\frac{U}{U+\frac{1}{2}I}$, the equilibrium offering price is then:

$$\hat{p}_2 = \frac{1}{1+\sqrt{\frac{U+I}{U}M}}V < p_U \tag{6}$$

In order to compare $\hat{p}_1$ and $\hat{p}_2$, from Equations 3′–5′, one can compare $\frac{U+\pi I}{U+I}$ and M. Some derivation leads to $\frac{U+\pi I}{U+I} < M$, and hence, $\hat{p}_2 > \hat{p}_1$.[6] That means holding other parameters constant, more informed investors are associated with higher offering price.

2.3.3 N imperfectly informed investors

When N imperfectly informed investors participate in the offering, there are $N+1$ outcomes with the number of informed investors truly knowing v being from 0 to N. Using similar procedure as in the previous section, one can derive the following equation:

$$\frac{U}{U+I}(V-p)^2 = \left(\sum_{k=0}^{N}\binom{N}{k}\pi^k(1-\pi)^{N-k}\frac{U}{U+\frac{N-k}{N}I}\right)p^2 \tag{7}$$

[6] Appendix A provides the full proof of the offering price increasing in the number of imperfectly informed investors in the general case.

The offering price when there are N informed investors, with I/N capital each, is:

$$\hat{p}_N = \frac{1}{1+\sqrt{\frac{U+I}{U}M}}V, \tag{8}$$

where $M = \sum_{k=0}^{N} \binom{N}{k}\pi^k(1-\pi)^{N-k}\frac{U}{U+\frac{N-k}{N}I}$. M can be interpreted as the expected value of uninformed investors' share, accounting for the possibility that some informed investors do not receive any signal in some states.

2.4 Comparative statistics and testable hypotheses

Equation 8 indicates that the equilibrium offering price is maximized when there are no informed investors ($I = 0$), in which case it equals $V/2$. With the participation of informed investors, the offering price decreases in their aggregate capital I (or their capital share $I/(U + I)$). That leads to my first hypothesis:

Hypothesis 1 *The offering yield is higher with the existence of local mutual funds and increases in their capital share.*

Hypothesis 1 implies that, local mutual funds, who are likely better informed about the bond's fundamental value, act as informed investors in the model, as opposed to retail investors and non-local investors, who are likely uninformed. Therefore, the presence of nearby mutual funds and their capital share create upward pressure on the offering yield.

Moreover, the model shows that the offering price increases in the number of informed investors N, holding other parameters constant. A complete proof can be found in Appendix A. This motivates my second hypothesis:

Hypothesis 2 *Holding aggregate local fund size constant, the offering yield declines in the number of local funds.*

Intuitively, hypothesis 2 can be explained by the assumption of independent signals, which implies that all informed investors receive signals together with a probability less than one. Therefore, the "expected informed capital" decreases in the number of informed investors, or local funds in this case. The offering price in equilibrium is then maximized when all potential investors are uninformed, minimized when there is one informed investor, and gradually reverts when there are more informed investors participating in the offering, holding the aggregate informed capital share constant.

For illustration, Figure 1 plots the sensitivity of the offering price to informed investors' capital share and, holding the share constant, to the number of informed investors.[7] Subfigure (a) shows that in equilibrium, the larger the capital share of informed investors, the lower the offering price. In subfigure (b), the difference in price is the largest when N increases from 0 (no informed investor) to 1 (one large informed investor). After that, the equilibrium price starts to increase gradually but never gets to $p_U = V/2$, given the existence of informed investors. In both subfigures, the sensitivity is stronger when π is larger, i.e., when informed investors have more accurate signals of the bond value.

Overall, the model suggests a V-shaped relation between bond offering price (yield) and the number of informed investors. The offering price is lower when there are informed investors participating in the offering. Yet, given the presence of informed investors, the offering price increases when there are more dispersed signals of bond value to different informed investors.

2.5 Discussions

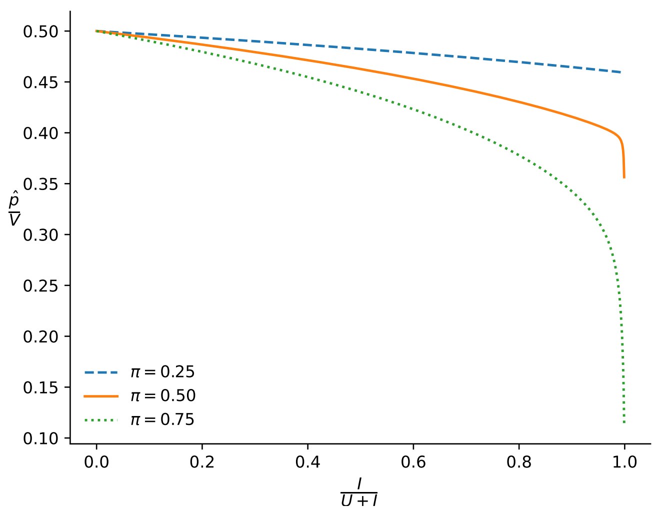
How good is this model at explaining municipal bond offerings? In comparison to equity IPOs, municipal bond offerings share similarities but also have distinct features. First,

[7] In the simulation, the number of informed investors, N, is set as 10, corresponding to the median number of local funds in my sample. The capital share of informed investors is set as 0.5, or $I = U$. The line shapes in Figure 1 generally do not change regardless of parameter values.

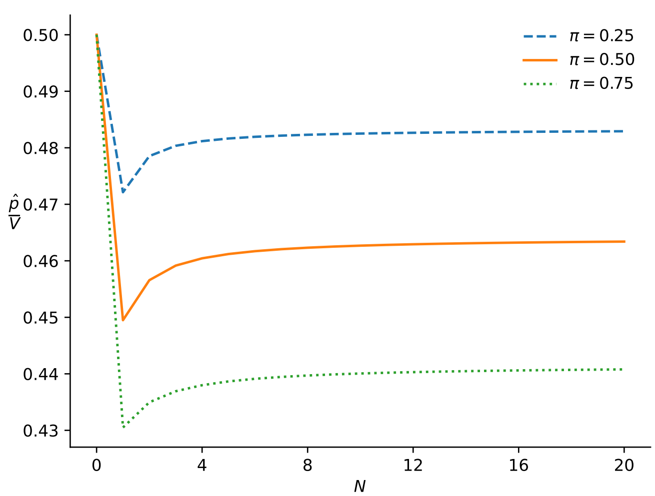
Figure 1
Offering price and informed investors

This figure plots the sensitivity of the equilibrium offering price $\hat{p}$, as a fraction of the upper bound V, to informed investors' capital share and the number of informed investors. The estimation is from Equation 8.

(a) Sensitivity of equilibrium price to informed investors' capital share
($N = 10$)



(b) Sensitivity of equilibrium price to the number of informed investors
($I = U$)



the offerings may require approval from voters through a bond referendum, especially for bond issues that rely on the taxing authority of the issuer for future payments (i.e., general obligation bonds). Second, muni bonds are often issued in series, with a single deal consisting of multiple bonds (CUSIPs) that share similar characteristics but have different maturity dates. Third, the two main types of offerings in the muni market are competitive sales and negotiated sales, which bear similarities to auctions and book building, respectively, in equity IPOs. In a competitive sale, underwriters submit bids to purchase the bond issue, and the underwriter (or underwriting syndicate) with the most favorable bid is selected. In a negotiated sale, the bond issue is directly sold to the underwriter (or underwriting syndicate) chosen by the issuer. Unlike in competitive sales, in negotiated sales, the underwriter can negotiate with the issuer on various aspects of the deal, such as the interest rate, offering price, or call features.[8] It is important to note that in both types of offerings, public investors in general do not purchase bonds directly from the issuer but rather from the underwriter.

The model in this section simplifies the actual security offering process by making some underlying assumptions. First, it assumes that there is only one issuer along with potential investors, without the involvement of an underwriter. Most bonds are offered to the public with the assistance of underwriters, and studies such as Benveniste and Spindt (1989) and Benveniste and Wilhelm (1990) explain IPO underpricing by focusing on the role of investment bankers in soliciting potential demand from the market and in allocating shares among buyers. Additionally, underwriters may be better at valuing the new bonds than issuers, particularly small ones, and retail investors, thus helping reduce the information mismatch between the informed and other market participants. In this model, it is assumed that the underwriter, if present, has access to the same information as the issuer and has no conflict of interest. This simplification enables the focus to be on the direct impact of informed investors on the equilibrium bond price and their informational advantage over the rest of

[8] http://www.msrb.org/glossary.aspx.

the market.

The second important assumption is that the signals available to different informed investors are independent, which may seem strict as investors may have correlated information, such as mutual funds within a fund family. My model requires this assumption only to yield an equilibrium offering price in closed form. The first prediction of higher offering yield in states with municipal funds does not rely on this assumption of independent signals. The second prediction, that the offering yield decreases in the number of local funds, holds as long as their signals are not perfectly correlated, which is a reasonable assumption.

Third, the bond value, v, is assumed to follow a uniform distribution. Again, this assumption is necessary for the model to be solvable in closed form. As long as there is uncertainty about v and informed investors are better, at least in some states, than the uninformed at valuing the bond, the offering yield will increase in the informed capital and decrease in the number of informed investors. Intuitively, uninformed investors need to be compensated by higher yields for their informational disadvantage resulting from bond value uncertainty and the potential participation of informed investors, regardless of the distribution of v. Otherwise, they would exit the market and the equilibrium cannot be achieved.

Another crucial assumption in the model is oversubscription. If a bond offering is not oversubscribed, regardless of the presence of informed investors, there would be no underpricing. Unfortunately, there are no readily available comprehensive data on the demand for bond issues. However, there is anecdotal evidence indicating that oversubscription is relatively common in the municipal market.[9]

Finally, my model emphasizes the information asymmetry channel through which local funds affect bond offering yields, assuming that local funds are more informed than other market participants, including retail investors and distance funds. As shown later in Sec-

[9] See, for example, articles from The Bond Buyer (November 2020), Yahoo Finance (November 2021), Financial Times (June 2022), and MunicipalBonds.com (July 2023).

tion 3, the presence of local funds is substantial: conditional on a bond being held by local funds within three months after issuance, the median holding amount is 26.74% of the offering amount. The participation of local funds thus can significantly affect the pricing of muni bonds at issuance. There are also other potential explanations for the same direction of effects. For example, local fund participation may simply indicate higher demand for bond issues, and a larger number of local funds may mean higher competition for the offering subscription, leading to lower yields. This demand explanation is consistent with my second hypothesis but not with the first one. My empirical analysis therefore provides evidence to pin down the information channel by showing that local funds are indeed informed and that their informational advantage, as proxied by abnormal fund returns, is positively related to bond yields in the primary market.

3 Data

3.1 Sample construction

The data sample comprises all municipal bond issues in the United States, excluding those issued by U.S. territories, between 2009 and 2019. Municipal bond characteristics are extracted from Capital IQ. Bonds included in the sample are fixed-rate or zero-coupon, tax-exempt, and have an offering amount of at least $100,000. County characteristics are derived from several sources, including Census, Bureau of Economic Analysis (BEA), and Bureau of Labor Statistics (BLS). Mutual fund data, originally sourced from Morningstar, are discussed in the following section. The final sample consists of 1,008,508 bond issues from 24,686 issuers, identified using 6-digit CUSIPs.

3.2 Yield spreads

In the literature on equity IPOs, underpricing is usually measured by the first-day return or the return over an initial period. However, since trading in the muni market is infrequent, this approach cannot be used as it would reduce the sample size significantly.[10] Therefore, this paper uses yield spread as a proxy for bond underpricing. As the main specification incorporates county, time, and rating fixed effects as well as time-varying bond and county characteristics, a higher yield spread implies higher underpricing relatively to other bonds issued in the same county, during the same month, and having similar characteristics. The underlying assumption is that similar bonds should be priced similarly. Consequently, if a bond is priced relatively low, its yield spread (price) is expected to gradually decrease (increase), akin to experiencing a positive initial return following the offering.

For each bond, I calculate yield spread as the difference between the bond's offering yield, obtained from Capital IQ, and the hypothetical yield of a "risk-free" bond that shares a similar payment schedule, using Treasury rates as discount rates. This approach, which removes the yield curve structure component from individual bonds' offering yields, is originally from Longstaff, Mithal, and Neis (2005). I also report results using tax-adjusted yield spreads, for which the offering yields are adjusted for federal and state taxes by a factor of $\frac{1}{(1-\tau_t^{fed})(1-\tau_{s,t}^{state})}$, in section 4.4.

3.3 Local funds

The variables of interest in the paper are various measures of local funds. In the main definition, local funds refer to all open-end municipal bond mutual funds whose operational headquarters are located in the same state as the bonds being offered. Fund headquarters are extracted from SEC filings, including N-SAR and N-CEN forms, reported by management companies. State borders are used to classify local funds due to the segmentation of the muni bond market. Since same-state investors mostly enjoy preferred tax treatment on their

[10] Cai, Helwege, and Warga (2007) employ first-week return to measure underpricing in corporate bond issues. This measure would only be available for less than 1% of the sample in this paper. This is due to the relatively low trading activity in the municipal bond market. For example, Green, Hollifield, and Schürhoff (2007) show that, in their sample of muni bond issues between 2000 and 2003, the median number of customer purchases within sixty trading days after issuance is only 4.

local bond holdings, munis are disproportionately invested in by these investors.[11] Given their close proximity to and familiarity with local economies, funds located in the same state are more likely to be informed than distance funds, even if the latter are close to the state borders.

As a robustness check for the main definition of local funds, I present several results using an alternative distance-based definition. I consider all U.S. open-end municipal bond mutual funds, but their characteristics, such as size, are discounted by the square root of the distance between their addresses and the issuer's county.[12] This definition provides measures that take into account mutual fund proximity to each specific issuer. However, compared to the main definition, it assigns lower weights to same-state funds that are not located in the same county, which are still potential purchasers of the new bonds. This is more problematic for large states with a small number of large funds.

Fund characteristics are obtained from the Morningstar Direct Mutual Fund database and are measured as of the previous month of the offering date. While most of the characteristics, such as fund size and portfolio holdings, are directly from Morningstar, the calculation of abnormal fund returns requires additional steps. Abnormal returns are estimated from twelve-month rolling window regressions of fund excess returns on several muni market factors constructed from Bloomberg Barclays indices plus the stock market's excess return. Appendix Table B1 provides detailed variable construction.

[11] Babina et al. (2021) focus on single-state funds and demonstrate that their holdings, influenced by tax-privileged policies, can affect the underlying local municipal bonds. In my analysis, I consider both single-state and national funds in the measures of local funds, as this paper emphasizes the impact on bond offerings of informed funds that are geographically close to the issuers, regardless of whether they benefit from tax policies.

[12] Fund addresses are first converted to counties. County distance data are then obtained from NBER. The main results remain similar if fund characteristics are discounted by two counties' distance, or its log, rather than its square root.

3.4 Summary statistics

Figure 2 illustrates the aggregate issuance amount by state during 2009–2019 and the number of open-end municipal funds in each state as of 2019. The municipal bond market is highly segmented, with most bonds being issued in states with relatively high economic activity. California, New York, and Texas are the three states with the largest issuance amounts. Municipal bond funds are concentrated in the East Coast, mostly in New York City, Boston, and Philadelphia. In contrast, many states, including large ones such as Florida, Georgia, and Michigan, do not have any local municipal funds.

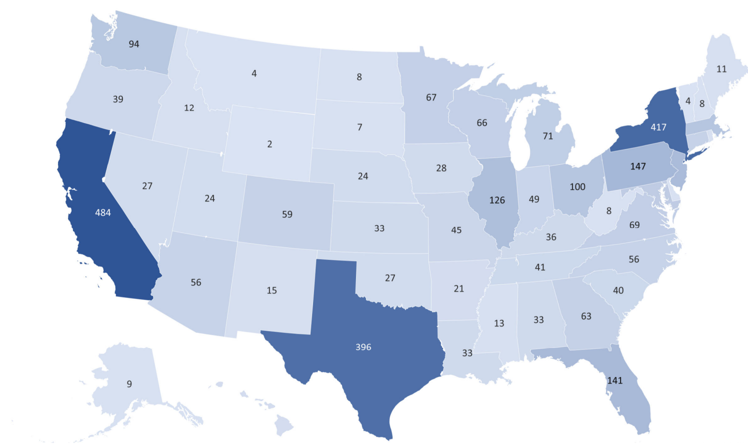
Table 1 presents the statistics of the main variables in the sample. Panel A shows that 79% of bond issues are in states with at least one municipal bond fund. This is consistent with Figure 2, since most bonds are issued in states with the largest number of funds. The median number of local funds is 12, belonging to 5 fund families. A typical bond issue is located in state whose aggregate total net assets, or TNA, amounts to $7.8 billion, reaching $50 billion in the 75th percentile. The mean (median) of aggregate local fund size, scaled by the county's population, is $140,000 ($20,000). Panel B reports similar statistics for distance-adjusted fund measures. The median aggregate adjusted TNA is $22.1 billion, averaging to $37.78 million per fund or $70,000 per capita. The median equal-weighted and TNA-weighted average distances from a bond's county to all U.S. municipal bond funds are 950 miles and 1,020 miles, respectively.

Panel C of Table 1 provides details of the characteristics of bonds in the sample. The majority of municipal bonds are not immediately held by local funds, with only 2% of bonds being purchased by local funds within three months of the offering date. Likewise, only 0.39% of the bond's offering amount is held by local funds. The number is small; yet conditional on the bond being held by at least one local fund, the (unreported) mean (median) of local fund holding is 20.71% (26.74%) of the offering amount. This suggests that local funds are among the main investors in the offering of local bonds, and their participation is significant

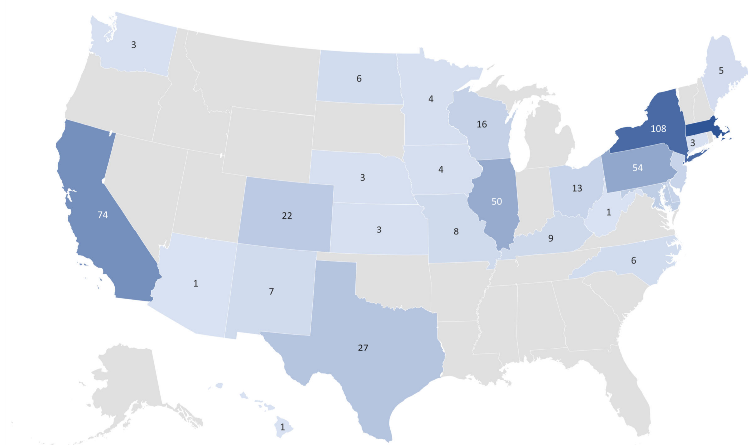
Figure 2
Municipal bond issuance and municipal bond funds in the United States

This figure plots the 2009–2019 municipal bond issuance amount and the number of open-end municipal bond funds as of 2019 by state. Darker colors indicate higher values.

(a) Issuance amount, in $ billions (2009–2019)



(b) Number of funds (2019)



enough to influence bond pricing.

The median bond has an offering yield of 2.40%, a yield spread of 0.32%, and a tax-adjusted yield spread of 1.94%. The median maturity at issuance is 9.05 years, offering amount is $0.72 million, and rating is AA. Of all bonds, only 0.20% are high yield. 48% of bonds in the sample are callable, 57% are general obligation bonds (versus revenue bonds), and 39% are bank qualified.

Table 1
Summary statistics

This table reports summary statistics for the sample of municipal bond issues and characteristics of local municipal bond funds. Bonds are required to be fixed rate, tax-exempt, and have offering amount of at least \$100,000. U.S.-territory bonds are excluded. Bond ratings are encoded so that AAA = 0, AA+ = 1, . . . , BB+ = 10, . . . , C = 20. Other variable definitions are in Appendix Table B1. The sample period is 2009–2019.

				Percentile		
	N	Mean	SD	25th	50th	75th
Panel A: Same-state fund characteristics						
Has funds	1,008,508	0.79	0.41	1.00	1.00	1.00
# funds	1,008,508	27.98	36.28	1.00	12.00	40.00
# families	1,008,508	5.07	5.10	1.00	5.00	7.00
Aggregate TNA (\$m)	1,008,508	31,570.93	43,266.18	115.03	7,778.77	49,798.90
Average TNA (\$m)	797,608	952.30	749.84	432.03	786.86	1,350.99
TNA per capita (\$m)	1,008,508	0.14	0.34	0.00	0.02	0.09
HHI TNA	797,608	0.25	0.26	0.08	0.14	0.29
Abnormal return (%)	785,806	-0.02	0.13	-0.07	-0.02	0.04
Panel B: Distance-adjusted fund characteristics						
Aggregate TNA (\$m)	1,008,508	27,053.81	16,569.37	18,013.54	22,139.80	29,752.84
Average TNA (\$m)	1,008,508	46.13	28.59	30.71	37.78	50.96
TNA per capita (\$m)	1,008,508	0.23	0.46	0.03	0.07	0.20
HHI TNA	1,008,508	0.02	0.02	0.01	0.01	0.02
Abnormal return (%)	1,008,508	-0.02	0.07	-0.06	-0.02	0.01
Average distance (thousand miles)	1,008,508	1.09	0.43	0.77	0.95	1.29
TNA-weighted distance (thousand miles)	1,008,508	1.14	0.35	0.89	1.02	1.28
Panel C: Bond characteristics						
Held by local funds	1,008,508	0.02	0.14	0.00	0.00	0.00
# local holding funds	1,008,508	0.02	0.20	0.00	0.00	0.00
Local fund holding/Offering amount (%)	1,008,508	0.39	3.02	0.00	0.00	0.00
Offering yield (%)	1,008,508	2.44	1.06	1.65	2.40	3.15
Yield spread (%)	1,008,508	0.39	0.57	-0.01	0.32	0.72
Tax-adjusted yield spread (%)	1,008,508	2.08	1.17	1.14	1.94	2.84
Maturity (years)	1,008,508	10.10	6.20	5.13	9.05	14.05
Offering amount (\$m)	1,008,508	2.90	17.56	0.32	0.72	1.97
Callable	1,008,508	0.48	0.50	0.00	0.00	1.00
General obligation bond	1,008,508	0.57	0.49	0.00	1.00	1.00
Bank qualified	1,008,508	0.39	0.49	0.00	0.00	1.00
Rating	1,008,508	2.50	1.82	1.00	2.00	3.00
High yield	1,008,508	0.00	0.04	0.00	0.00	0.00
Panel D: County characteristics						
GDP (\$b)	1,008,508	63.35	119.36	4.62	19.02	67.39
Population (millions)	1,008,508	0.89	1.53	0.12	0.37	0.92
Average wage (\$000s)	1,008,508	49.14	13.91	39.64	46.63	55.64
House value (\$000s)	1,008,508	222.44	143.79	132.70	174.60	253.80
Unemployment rate (%)	1,008,508	6.01	2.63	4.00	5.50	7.60
Median age (years)	1,008,508	37.54	4.17	34.70	37.30	40.30
High school graduate (%)	1,008,508	87.10	5.73	84.60	88.20	91.20
Tax privilege (%)	1,008,508	4.76	3.87	0.00	5.00	7.85

Last, Panel D reports county characteristics. The median bond is located in a county with GDP of \$19.02 billion and population of 0.37 million. Individual wealth is measured using average yearly wage and housing value, with median values of \$46,630 and \$174,600, respectively. The average (median) unemployment rate, at the county level, is 6.01% (5.50%).

A typical bond's county has a population age of 37.30 years and 88.20% of the population have at least a high school diploma.

Given that the primary analyses in this paper rely on the time-series variations of the variables of interest, I provide the time-series plots of yield spreads and open-end municipal bond funds in Figures IA1–IA2 in the Internet Appendix. Over time, yield spreads have generally exhibited a declining trend, with the exception of the 2010–2013 period. This particular period can be attributed to concerns over municipal defaults, with the peak being the Detroit bankruptcy in July 2013. The number of municipal funds has shown a downward trend, decreasing from 652 funds in January 2009 to 567 funds in December 2019. However, during the same period, their aggregate TNA more than doubled, increasing from \$360 billion to \$820 billion. Internet Appendix Table IA1 provides a further breakdown of the number of muni funds and their aggregate TNA by state. Notably, between 2009 and 2019, 17 states did not have any municipal funds at all.

4 Results

4.1 Yield spreads and local funds

To formally test the two hypotheses suggested by the model in section 2, I examine the relation between an issue's yield spread and various measures of local funds. My primary specification is as follows:

$$\textit{Yield spread}_{b,c,t} = \alpha_c + \alpha_r + \alpha_t + \beta \times \textit{Local funds}_{s,t-1} + \eta' \mathbf{X}_{b,c,t} + \varepsilon_{b,c,t}, \tag{9}$$

where b indexes bonds, c indexes counties, s indexes states, r indexes ratings, and t indexes times of issuance in year-months. *Local funds* measures include 1) an indicator that there exists any open-end municipal bond fund located in the same state, 2) the natural logarithm of aggregate local fund size (TNA), 3) aggregate local fund size per capita, 4) log of number of local funds, and 5) local fund size Herfindahl-Hirschman index (HHI). My theoretical framework implies that, compared to bonds in states without local funds, those in states having local funds have higher yield spreads. Meanwhile, conditional on aggregate fund size, yield spreads decrease in the number of local funds, or equivalently, increase in their HHI.

An array of control variables is included in the regressions. Bond characteristics include log of bond maturity, log of offering amount, and indicators for callable bond, general obligation (GO) bond, and bank-qualified bond. County characteristics include log of GDP, log of population, logs of average wage and housing value, median population age, and the percentage of the population with at least a high school diploma. All regressions include county, year-month, and rating fixed effects to control for unobservable characteristics of bonds located in the same county, being assigned a similar rating, and being issued around the same time. Baseline results are reported in Table 2.

Column 1 of Table 2 shows that bonds located in states with local muni funds have higher yield spreads by 6.6 bps than those not. The difference is significant both statistically and economically, given that the mean (median) yield spread in the sample is 39 bps (32 bps). Similarly, conditional on having at least one local fund, there exists a positive correlation between the log of aggregate local fund size and bond yield spreads in column 2. When the aggregate local fund size doubles, yield spreads increase by 1.8 bps, which is significant at the 1% level. To put it another way, a one standard deviation increase in the log of local fund size is associated with a higher yield spread by 4.3 bps.

Column 2 uses log of absolute local fund TNA, while Hypothesis 1 implies a relation between yield spreads and the informed capital share of total capital. Therefore, I scale aggregate local fund size by the county's population as of the previous year in column 3. If local residents are potential uninformed investors in the muni market, then Hypothesis 1 would be supported by a positive relation between bond yield spreads and local fund size per capita. This is what I document in column 3, with yield spreads increasing by 2.7 bps

Table 2
Yield spreads and local mutual funds

This table reports results of regressions of a bond's yield spread on measures of local municipal bond funds:

$$\textit{Yield spread (\%)}_b = \alpha_c + \alpha_r + \alpha_t + \beta \times \textit{Local funds}_{s,t-1} + \eta' \mathbf{X}_{b,c,t} + \varepsilon_{b,c,t},$$

where b indexes bonds, c counties, s states, r ratings, and t times of issuance in year-months. Local fund measures are based on open-end municipal bond funds located in the same state as the bond's issuer as of the previous month of the offering. *Has funds* = 1 if the bond's state has at least one open-end municipal bond fund (*local fund*) and 0 otherwise. *Ln(TNA)* is the log of the aggregate total net assets of all local open-end municipal bond funds. *TNA per capita*, in $ millions, is the ratio of the aggregate total net assets of all local open-end municipal bond funds to the population of the bond's county. *Ln(# funds)* is the log of the number of local open-end municipal bond funds. *Ln(HHI TNA)* is the size-based Herfindahl–Hirschman index of local open-end municipal bond funds. Other variable definitions are in Appendix Table B1. In columns 2, 4, and 5, the sample is restricted to bond issues in states with at least one open-end municipal bond fund. Standard errors are adjusted for clustering by state and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

	(1)	(2)	(3)	(4)	(5)
Has funds$_{s,t-1}$	0.066***				
	(0.012)				
Ln(TNA)$_{s,t-1}$		0.018***		0.047***	0.034***
		(0.005)		(0.011)	(0.008)
TNA per capita$_{c,t-1}$			0.080***		
			(0.025)		
Ln(# funds)$_{s,t-1}$				−0.066***	
				(0.012)	
Ln(HHI TNA)$_{s,t-1}$					0.061***
					(0.015)
Ln(Maturity)$_b$	0.232***	0.234***	0.232***	0.234***	0.234***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Ln(Offering amount)$_b$	−0.009***	−0.010***	−0.009***	−0.010***	−0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Callable$_b$	0.229***	0.223***	0.229***	0.224***	0.224***
	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)
General obligation bond$_b$	−0.088***	−0.079***	−0.088***	−0.079***	−0.079***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Bank qualified$_b$	−0.151***	−0.154***	−0.151***	−0.154***	−0.154***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Ln(GDP)$_{c,t-1}$	−0.126***	−0.150***	−0.126***	−0.143***	−0.151***
	(0.022)	(0.026)	(0.022)	(0.026)	(0.026)
Ln(Population)$_{c,t-1}$	−0.271***	−0.266***	−0.221***	−0.251**	−0.225**
	(0.075)	(0.099)	(0.077)	(0.097)	(0.094)
Ln(Average wage)$_{c,t-1}$	0.230***	0.213***	0.231***	0.185**	0.199**
	(0.067)	(0.078)	(0.067)	(0.079)	(0.078)
Ln(House value)$_{c,t-1}$	0.267***	0.212***	0.245***	0.227***	0.207***
	(0.051)	(0.068)	(0.051)	(0.068)	(0.066)
Unemployment rate (%)$_{c,t-1}$	0.035***	0.041***	0.037***	0.041***	0.042***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Median age$_{c,t-1}$	0.001	0.000	0.001	0.002	0.001
	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)
High school graduate (%)$_{c,t-1}$	0.003	−0.004	0.003	−0.004	−0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
N	1,008,508	797,608	1,008,508	797,608	797,608
Adjusted R^2	0.68	0.68	0.68	0.68	0.68
County FEs	✓	✓	✓	✓	✓
Year–Month FEs	✓	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓

(= $0.34 \times 0.080\%$) when local TNA per capita increases by one standard deviation.

Another concern is the presence of other municipal bond investors, such as insurance companies, banks, and non-local funds. With the assumption that local funds are more informed than other institutional investors due to their geographic proximity and local knowledge, such a concern is mitigated by the inclusion of time fixed effects in the regressions. At any given point in time, the aggregate size of all U.S. investors is fixed. Therefore, my estimate of local fund size can also be interpreted as the fraction of U.S. total capital held by local muni funds, which is exactly what Hypothesis 1 suggests.

Results in columns 1–3 of Table 2 are supportive of Hypothesis 1. Alternatively, local funds can also impact bond pricing through the demand channel. However, the potentially higher demand driven by local funds would lead to lower yield spreads rather than higher ones.[13] This indicates that while the demand channel exists, it is outweighed by the information asymmetry channel. Hence, the true effect of the latter channel is likely underestimated in Table 2.

To test Hypothesis 2, I use the log of number of local funds and their HHI as explanatory variables in columns 4–5. Conditional on having at least one local fund and holding aggregate fund size fixed, bond yield spreads decrease by 6.6 bps when the number of local funds doubles. Similarly, yield spreads are higher by 6.1 bps when the HHI of local funds' TNAs is twice as large. Both coefficient estimates are equivalent to 16–17% of the sample average and are statistically significant at the 1% level.

The results in Table 2 are derived from the time-series variations in yield spreads and local funds measures, which may raise concerns that any observed correlation is driven by a time trend. In my analysis, this is unlikely to be the case. Internet Appendix Figures IA1–

[13] Adelino et al. (2022) find that larger fund flows are associated with increased bond issuance and lower offering yields. There is a distinction in the focus of the study, as I examine geographically local funds, or informed investors, while Adelino et al. (2022)'s analysis is centered on the short-term capital supply shocks from funds that hold outstanding bonds issued by the same municipalities as the new bonds.

IA2 demonstrate that yield spreads have been decreasing over the sample period; meanwhile, the number of muni funds (their aggregate TNA) has been decreasing (increasing). Therefore, the positive (negative) association between bond yield spreads and local fund size (the number of local funds), as documented in Table 2, cannot be solely attributed to a time trend.

The coefficient estimates of control variables in Table 2 are generally consistent with the literature. Bonds with shorter maturities, larger bonds, non-callable bonds, general obligation bonds, and bank-qualified bonds have lower yield spreads on average, as these bond characteristics often indicate lower risk and are associated with higher bond pricing. Meanwhile, yield spreads are lower for bonds in larger counties with higher economic activities and lower unemployment rates. On the contrary, bond yield is higher when local residents are more wealthy, i.e., when average wage and housing value are higher. This can be attributed to wealthier local retail investors being more informed, and thus demanding higher yields from their investment.

For robustness, Internet Appendix Table IA2 replicates Table 2 with distance-adjusted fund measures, for which fund characteristics are discounted by the square root of the distance between their headquarters and the bond's county. The results are consistent with Table 2, that is, bond yield spreads are higher when distance-adjusted fund size (per capita) is larger and when fund capital is more concentrated. Columns 4–5 examine the average distance between the bond's and funds' counties as a determinant of bond yield spread. When the average distance, equal-weighted, increases by one standard deviation (430 miles), yield spreads increase by 96 bps ($= 0.43 \times 2.243\%$). In contrast, yield spreads decrease by 41 bps for every standard deviation (350 miles) increase in the TNA-weighted distance measure. These seemingly contradictory result are consistent with the model implications: bond yield is predicted to be higher when there are a few large, dominant funds nearby (*TNA-weighted distance* result) but lower when local funds are relatively small compared to distance funds (*equal-weighted distance* result), assuming that small local funds are less informed relative to their large non-local competitors.

Overall, results in Table 2, corroborated by Internet Appendix Table IA2, support both Hypotheses 1 and 2. Yield spreads are higher when there are local muni funds with larger size; yet, they decrease in the number of funds, holding local fund size fixed.

4.2 Are local funds buying?

The previous section provides supportive evidence of how local municipal bond funds potentially affect the pricing of bond issues, implicitly assuming that local funds are purchasers of the new bonds. Although this is a reasonable assumption, some funds may not invest in local bonds for several reasons, such as investment mandates or budget constraints. Such funds should be excluded from the calculation of informed capital and the number of informed investors. To link local funds' actual interests in new issues to bond pricing, in this section, I use local funds' reported holdings, up to three months since the offering date, as a proxy for their interests in the offerings. Given the illiquidity of the municipal bond market and the rarity of bond rating changes, mutual funds are unlikely to adjust their holdings shortly after the issuance. Therefore, their initial interests in the new bond issues should be well approximated by the subsequent reported holdings.

There are unfortunately several endogeneity concerns when studying the effect of local funds' participation in the primary market on the pricing of new bond issues. One of these concerns is the possibility of reverse causality, where mutual funds choose to locate themselves in states with high-yield bonds in order to "reach for yield", a strategy already documented in the literature (Becker and Ivashina, 2015; Choi and Kronlund, 2018). Additionally, under certain market conditions, funds that invest in bonds having high yields may experience a large increase in their portfolio value, while at the same time, new bond issues may have high yield spreads. In order to establish a causal relation between local fund participation and new bond pricing, an instrumental variables analysis is employed.

In this analysis, the potentially endogenous measures of local funds' holdings, within three months of the offering date, are instrumented with the differences between the new issue's characteristics and those of outstanding bonds held by local funds just before the issuance. I calculate the value-weighted average for each characteristic across all bonds held by each local fund. Next, I take the TNA-weighted average across all local funds and then obtain the absolute value of the difference between that average and the new bond's characteristic measure.[14] I use the following characteristics to construct the instruments: offering amount, maturity, callability, general obligation versus revenue bond, bank qualification, and high yield versus investment grade rating. These characteristic-based measures are relevant instruments because mutual funds have investment mandates from which they cannot deviate too far.[15] To further explain, fund mandates are reflected in the characteristics of their portfolios, and the more similar the new bond is to bonds held by local funds, the more likely it is purchased by local funds.

Table IA5 in the Internet Appendix confirms the significant relations between local holding measures and their instruments. It shows that local funds are significantly more likely to invest in new issues when the bond similarity level is higher. As a hypothetical example, when local funds invest exclusively in GO bonds, they are 1.7% more likely to invest in the new issue when it is also GO bond than when it is not. This difference is economically meaningful since the sample average propensity for a bond to be purchased by at least one

[14] Internet Appendix Table IA4 presents the statistics of the value-weighted average characteristics of bonds held by local funds across states and over time. Panel A provides the cross-sectional statistics of the state-specific time-series averages, while Panel B presents the time-series statistics of the across-state cross-sectional averages. The means and medians show relatively similar values between the two panels. However, the cross-sectional standard deviations are considerably larger than the time-series standard deviations. This suggests that there is substantial variation in the characteristics of bonds held by local funds across states, whereas the nationwide-average bond characteristics exhibit less variation over time.

[15] This approach is similar to that used by Koijen and Yogo (2019) and Bretscher et al. (2020), who use instruments for institutional investors' holdings in the secondary market with the same argument. They form a hypothetical universe of securities that each investor potentially invests in, and use that to construct a hypothetical holding measure as an instrument for the actual holding by aggregate investors.

local fund is only 1.8%. Likewise, more local funds invest and with a larger investment as a fraction of the bond's offering amount when the new bond is more similar to bonds already held by local funds. The Kleibergen-Paap test statistics shown in Table 3 further confirm that a problem with weak instruments is unlikely.

The exclusion restriction is that, controlling for other variables, the characteristic-deviated instruments only impact the pricing of new issues through the investment by local funds, and not through any other channels. There are concerns that in order to attract higher demand, some issuers with high costs of financing may set the characteristics of their bonds to better align with local funds' portfolios. This potential channel, if true, would predict lower yield spreads associated with local funds' primary market participation, implying that the IV analysis would underestimate the true (positive) relation between local funds—informed investors—and bond yield spreads. It is also worth mentioning that among characteristics used to construct the instruments, bond rating is assigned by credit rating agencies, while others, such as maturity and offering amount, are determined by specific funding needs and in many cases require approval by voters in referendums, leaving limited room for manipulation. Importantly, all regressions include bond characteristics as control variables, so the instruments' variations are expected to reflect solely the relevance of the new bond to its potential buyers, specifically local funds. Since it is highly unlikely that potential omitted variables are reflected in the instruments but not controlled by bond characteristics, the exclusion restriction is satisfied as well.

Table 3 reports the second-stage results of 2SLS regressions of bond yield spreads on local holding measures.[16] Column 1 shows that bonds held by local funds have higher yield spreads by 27 bps than those not, equivalent to 46% of the sample standard deviation. This estimate

[16] In column 1, since the main explanatory variable is binary, a modified estimation procedure is implemented: 1) regress the endogenous variable on the instruments and control variables; and 2) use the fitted value from the previous step as the instrument for the 2SLS estimation (Wooldridge, 2010). This also helps explain why, despite the fairly similar first-stage coefficient estimates between columns 1 and 3 of Internet Appendix Table IA5, the second-stage results differ between columns 1 and 3 of Table 3.

Table 3
Instrumental variable analysis: second stage

This table reports second-stage results of instrumental variable regressions of a bond's yield spread on its holding by local municipal bond funds within three months of the offering date:

$$\textit{Yield spread (\%)}_b = \alpha_c + \alpha_r + \alpha_t + \beta \times \textit{Local holding}_{b,3m} + \eta'\mathbf{X}_{b,c,t} + \varepsilon_{b,c,t},$$

where b indexes bonds, c counties, s states, r ratings, and t times of issuance in year-months. *Held by local funds* = 1 if the bond is held by at least one local open-end municipal bond fund within three months of the offering date and 0 otherwise. *Local fund holding/Offering amount* is the ratio of all local funds' holding of the bond, within three months of the offering date, to the bond's offering amount. *# local holding funds* is the number of local funds that hold the bond within three months of the offering date. *Local holding* measures are instrumented with the absolute differences between the new issue and bonds held by local funds with respect to offering amount, maturity, callability, general obligation versus revenue bond, bank qualification, and high yield versus investment grade rating. *Few local holding funds* indicates whether there is at most one local fund holding the bond within three months of the offering date. Other variable definitions are in Appendix Table B1. The sample is restricted to bond issues in states with at least one open-end municipal bond fund with holding information in order to construct the instruments. Standard errors are adjusted for clustering by state and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

	(1)	(2)	(3)	(4)
Held by local funds$_{b,3m}$	0.265***			
	(0.041)			
Local fund holding/Offering amount (%)$_{b,3m}$		0.149***		
		(0.022)		
Ln(1 + # local holding funds)$_{b,3m}$			−1.584***	−1.566***
			(0.303)	(0.564)
Ln(1 + # local holding funds)$_{b,3m}$× Few funds$_{b,3m}$				4.199***
				(0.700)
Few local holding funds$_{b,3m}$				−2.204***
				(0.684)
Ln(Maturity)$_b$	0.235***	0.215***	0.247***	0.228***
	(0.005)	(0.006)	(0.006)	(0.006)
Ln(Offering amount)$_b$	−0.017***	−0.071***	0.025***	−0.044***
	(0.002)	(0.009)	(0.007)	(0.007)
Callable$_b$	0.222***	0.234***	0.215***	0.228***
	(0.006)	(0.007)	(0.006)	(0.006)
General obligation bond$_b$	−0.073***	−0.027***	−0.098***	−0.052***
	(0.004)	(0.009)	(0.005)	(0.007)
Bank qualified$_b$	−0.158***	−0.166***	−0.138***	−0.163***
	(0.005)	(0.006)	(0.006)	(0.005)
Ln(GDP)$_{c,t-1}$	−0.147***	−0.145***	−0.140***	−0.146***
	(0.026)	(0.031)	(0.026)	(0.027)
Ln(Population)$_{c,t-1}$	−0.265***	−0.191*	−0.324***	−0.224**
	(0.100)	(0.112)	(0.103)	(0.104)
Ln(Average wage)$_{c,t-1}$	0.201**	0.264***	0.145*	0.221***
	(0.078)	(0.094)	(0.082)	(0.083)
Ln(House value)$_{c,t-1}$	0.225***	0.225***	0.229***	0.224***
	(0.069)	(0.077)	(0.069)	(0.071)
Unemployment rate (%)$_{c,t-1}$	0.041***	0.035***	0.044***	0.038***
	(0.004)	(0.004)	(0.004)	(0.004)
Median age$_{c,t-1}$	0.003	0.007	0.000	0.006
	(0.004)	(0.004)	(0.004)	(0.004)
High school graduate (%)$_{c,t-1}$	−0.004	−0.003	−0.004	−0.003
	(0.003)	(0.004)	(0.003)	(0.003)
N	774,774	774,774	774,774	774,774
Underidentification LM statistic	566.35	135.43	198.73	174.45
Weak identification F statistic	2,501.46	23.21	34.39	17.33
County FEs	✓	✓	✓	✓
Year–Month FEs	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓

is substantially larger than the OLS estimate in Table 2. This difference can be attributed to the fact that Table 2 compares yield spreads of bonds with and without municipal funds nearby but does not account for the possibility that local funds may not participate in the offerings. Therefore, the estimate in Table 2 is likely a lower bound for the real effect.

I provide further corroborating evidence in columns 2–4 which use the aggregate bond holding by local funds and the number of local funds that invest, both measured within three months of the offering date, as explanatory variables. Yield spreads are higher by 15 bps for every 1% of the bond's offering amount purchased by local funds. Meanwhile, there is a negative relation between bond yield and the number of local funds holding the bond. In column 3, a one standard deviation increase of 0.125 in *Ln(1+#local holding funds)* is associated with 20 bps ($= 0.125 \times 1.584\%$) lower yield spreads. Column 4 further shows that such an increase in *Ln(1+#local holding funds)* leads to 33 bps ($= 0.125 \times (4.199 - 1.566)\%$) higher yield spreads when there is one rather than zero local holding fund. Yet, it is associated with a 20 bps ($= 0.125 \times 1.566\%$) decline in yield spreads when there is more than one local fund that invest in the new bonds, consistent with the V-shaped relation implied from the model.

Overall, after controlling for endogeneity, I still find a significant and model-consistent non-monotonic impact of local funds' primary market participation on the pricing of new issues, indicating that my previous results are robust to this IV approach.

4.3 Are local funds informed?

The results presented in the previous tables provide evidence for the relation between local fund participation in bond offerings and initial yield spreads. There are nevertheless several channels through which local funds can impact bond pricing in the primary market. First, as the model in section 2 suggests, local funds are informed investors, and their participation necessitates bond underpricing to compensate for the winner's curse faced by uninformed investors. Second, higher demand resulting from local funds' participation may push bond yields lower. This is however inconsistent with the results in Tables 2 and 3. Third, issuers may set the offering yields higher to attract local funds, which are large investors with high bargaining power in the local market. In order to fully support the information asymmetry channel, I need to demonstrate that local funds are more informed than other investors. There has been evidence that local investors, in particular local mutual funds, are informed in equity markets (see, for example, Coval and Moskowitz, 2001; Baik, Kang, and Kim, 2010); yet, the evidence on bond markets is limited.

It is difficult to make comparisons between local funds and retail investors since the latter's investments are not identifiable in the data, but it is reasonable to assume that they are less informed than sophisticated mutual funds. The next question is whether local funds are more informed than other institutional investors. In this section, I present evidence showing that local funds are better than non-local funds at investing in bonds with a high (low) propensity for rating upgrades (downgrades). I consider bond rating changes as trading is thin in the muni market, which makes it challenging to measure bond returns or changes in bond yields on a monthly or even quarterly basis. Using a sample of mutual fund holdings,[17] the specification is as follows:

$$Upgrade/Downgrade_{b,t\rightarrow t+\tau} = \alpha_{f,t} + \alpha_{c,t} + \alpha_r + \beta \times Same\ state_{b,f,t} + \eta' \mathbf{X}_{b,f,t} + \varepsilon_{b,f,t}, \quad (10)$$

where b indexes bonds, c indexes counties, f indexes funds, r indexes ratings, and t indexes year-months. The unit of observations is fund-time-bond. The dependent variable, expressed as either -100, 0, or 100, indicates whether the bond's rating is upgraded (100) or downgraded (-100) within the next three or six months after the holding reporting date. To simplify the analysis, observations that involve both upgrade(s) and downgrade(s) within the next six

[17] Different from the main sample of municipal bond issues, this sample includes all bond holdings by open-end municipal bond funds between 2009 and 2019.

months are excluded. In all regressions, I include bond county by year-month fixed effects; and in the strictest specification, I also include fund by year-month by rating fixed effects. Thus, the main explanatory variable, *Same state*, measures, for a given fund at a given time, whether its local holdings are more or less likely to have a positive rating change than its distance holdings with the same rating. Table 4 reports the results.

Table 4
Informational advantage: bond rating changes

This table reports results of regressions of a bond's future rating upgrade/downgrade propensity on the indicator that it is local:

$$Upgrade/Downgrade_{b,t\rightarrow t+\tau} = \alpha_{f,t} + \alpha_{c,t} + \alpha_r + \beta \times Same\ state_{b,f,t} + \eta'\mathbf{X}_{b,f,t} + \varepsilon_{b,f,t},$$

where b indexes bonds, f funds, r ratings, and t year-months. The dependent variable = 100 (-100) if the bond's credit rating is upgraded (downgraded) by either Moody's, S&P, or Fitch within the next three or six months, and 0 if there is no rating change. Bonds with both rating upgrade(s) and downgrade(s) within the next six months are excluded. *Same state* = 1 if the bond's issuer and the fund's headquarters are located in the same state and 0 otherwise. Other variable definitions are in Appendix Table B1. The sample includes all holdings by open-end municipal bond funds between 2009 and 2019. The unit of observations is fund-time-bond. Standard errors are adjusted for clustering by bond and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

	Within 3 months		Within 6 months	
	(1)	(2)	(3)	(4)
Same state$_{b,f,t}$	0.421***	0.427***	0.641***	0.654***
	(0.154)	(0.153)	(0.241)	(0.237)
Ln(Holding par)$_{b,f,t}$	−0.105**	−0.140***	−0.183***	−0.245***
	(0.042)	(0.037)	(0.063)	(0.056)
Bond yield (%)$_{b,f,t}$	−0.464***	−0.368***	−0.765***	−0.649***
	(0.059)	(0.048)	(0.083)	(0.083)
Ln(Bond age)$_{b,t}$	−0.209	−0.232	−0.288	−0.308
	(0.252)	(0.228)	(0.332)	(0.304)
Ln(Maturity)$_{b,t}$	−0.441***	−0.498***	−0.740***	−0.796***
	(0.124)	(0.110)	(0.199)	(0.181)
Ln(Offering amount)$_b$	0.201**	0.216***	0.354***	0.370***
	(0.081)	(0.075)	(0.114)	(0.107)
Callable$_b$	0.744***	0.628***	1.216***	1.035***
	(0.191)	(0.169)	(0.270)	(0.239)
General obligation bond$_b$	−0.159	−0.275	−0.041	−0.201
	(0.437)	(0.433)	(0.604)	(0.583)
Bank qualified$_b$	0.179	0.360*	0.315	0.644*
	(0.229)	(0.216)	(0.364)	(0.332)
N	8,436,828	8,436,828	8,436,828	8,436,828
Adjusted R^2	0.27	0.36	0.28	0.36
Bond County×Year-Month FEs	✓	✓	✓	✓
Fund×Year-Month FEs	✓		✓	
Rating FEs	✓		✓	
Fund×Year-Month×Rating FEs		✓		✓

The coefficient on *Same state* is positive in all specifications in Table 4, controlling for position size and bond characteristics. Specifically, column 2 indicates that a fund's local holdings are 0.43% more (less) likely to experience a rating upgrade (downgrade) within the following three months. A similar estimate for the next six months, as reported in column 4, is 0.65%.[18] It might be argued that mutual funds invest in risky distance bonds so that their higher yields compensate for the disadvantaged tax treatment. This concern is addressed by bond county-time fixed effects, allowing for comparison of the rating change propensity of bonds in the same county. Therefore, results in Table 4 suggest that mutual funds are better at selecting local bonds than distance bonds, at least in terms of predicting future rating changes.

To directly link local funds' informational advantage with bond pricing, I examine the relation between local funds' abnormal returns and bond yield spreads in Table 5. As briefly discussed in section 3, abnormal fund returns are estimated as the residuals from twelve-month rolling window regressions of net returns, in excess of the risk-free rate, on four muni bond market factors plus excess return in the stock market. Abnormal performance is used as a proxy for how informed a fund is. Admittedly, this proxy is not perfect; however, a significant portion of the fund's abnormal performance should be attributable to its local informational advantage.

The results in Table 5 are consistent with my conjecture. Controlling for aggregate fund size, when local, same-state funds outperform their benchmark by 1%, offering yield spreads increase by 8.7 bps, which is significant at the 1% level and equal to 22% of the yield spread sample average. Similarly, using distance-adjusted fund measures, a one-standard-deviation (0.07) change in abnormal distance-adjusted returns is positively associated with a 3 bps ($= 0.07 \times 0.431\%$) change in yield spreads.

Overall, Tables 4–5 emphasize the informational advantages of local funds and highlight the information asymmetry channel as the primary explanation for the main results. The

[18] For reference, among the sample, 4.05% (7.91%) have at least one rating upgrade within three (six) months, while 4.90% (8.92%) have at least one rating downgrade within three (six) months.

Table 5
Yield spreads and local mutual fund performance

This table reports results of regressions of a bond's yield spread on local municipal bond funds' abnormal returns:

$$\textit{Yield spread (\%)}_b = \alpha_c + \alpha_r + \alpha_t + \beta \times \textit{Local abnormal fund returns}_{s,t-1} + \eta' \mathbf{X}_{b,c,t} + \varepsilon_{b,c,t},$$

where b indexes bonds, c counties, s states, r ratings, and t times of issuance in year-months. Local funds' abnormal returns are estimated from the twelve-month rolling window regressions of monthly fund returns on market factors: 1) aggregate bond factor—Bloomberg Barclays U.S. Aggregate Bond Index return in excess of risk-free rate; 2) muni bond factor—the difference between U.S. Municipal Index return and U.S. Aggregate Bond Index return; 3) high yield factor—the difference between U.S. High Yield Municipal Bond Index return and U.S. Municipal Index return; 4) term structure factor—the difference between U.S. Municipal Index return and U.S. Government/Credit 1-3 Year Index return; and 5) Fama-French stock market excess return. Local fund measures are based on open-end municipal bond funds located in the same state as the bond's issuer as of the previous month of the offering. Adjusted local fund measures are based on all U.S. open-end municipal bond funds, with fund size being discounted by the square root of distance between the bond's and the fund's counties. Other variable definitions are in Appendix Table B1. Standard errors are adjusted for clustering by state and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

	Same-state funds	Distance-adjusted funds
	(1)	(2)
Abnormal fund return $(\%)_{s,t-1}$	0.087***	0.431***
	(0.029)	(0.152)
$\text{Ln(TNA)}_{s,t-1}$	0.020***	0.336***
	(0.007)	(0.052)
Ln(Maturity)_b	0.234***	0.231***
	(0.005)	(0.004)
$\text{Ln(Offering amount)}_b$	−0.010***	−0.009***
	(0.001)	(0.001)
Callable_b	0.224***	0.230***
	(0.006)	(0.005)
General obligation bond_b	−0.079***	−0.088***
	(0.004)	(0.004)
Bank qualified_b	−0.155***	−0.151***
	(0.005)	(0.004)
N	785,806	1,008,508
Adjusted R^2	0.68	0.68
County controls	✓	✓
County FEs	✓	✓
Year–Month FEs	✓	✓
Rating FEs	✓	✓

results support the notion that the higher the level of information possessed by local funds, as proxied by their abnormal performance, the higher the yield spreads, which is consistent with the prediction in the model in section 2.

4.4 Tax advantages

As income from municipal bonds is exempt from federal taxation and likely state taxation as well, previous research has demonstrated that this tax advantage is one determinant of borrowing costs (Garrett et al., 2023). Furthermore, Babina et al. (2021) document that varying tax policies across states can incentivize local investors, particularly state funds, to invest in local bonds. As a result, this dynamic has several impacts on the underlying bonds, such as concentrated ownership and exposure to local idiosyncratic risk. This tax incentive channel potentially conflicts with the information asymmetry channel when it comes to explaining how local funds influence the pricing of local bond issues. In Table 6, I investigate how the baseline results are affected when considering tax privileges across different states.

Following Babina et al. (2021), I calculate tax privilege as the difference between the highest state income tax rate applicable to muni bonds issued in other states and the highest state income tax rate applicable to in-state muni bonds. The interactions of tax privilege with the local fund dummy and local fund size are both negative, indicating that the positive association between yield spreads and local funds documented in Table 2 is weaker in states with higher tax privilege. This could be attributed to higher tax-induced demand from local investors in such states, leading to lower bond yields.

Among states with zero tax privilege, i.e., without tax incentivization, states with at least one local munil fund are associated with higher bond yield spreads by 15.3 bps. Similarly, the coefficient on local fund size is 9.6 bps. Both estimates are significantly larger than those in Table 2, indicating even stronger results than the baseline when the potential effect of tax advantages is isolated.

Another tax-related question is whether yield spread—the main dependent variable in my analysis—should be adjusted for taxes. Given the tax treatment for most municipal bonds, tax-adjusted yield spreads are studied in some research to incorporate the wedge in

Table 6
Tax privilege

This table reports results of regressions of a bond's yield spread on measures of local municipal bond funds interacted with state-level tax privilege:

$$\textit{Yield spread (\%)}_b = \alpha_c + \alpha_r + \alpha_t + \beta \times \textit{Local funds}_{s,t-1} \times \textit{Tax privilege}_{s,t} + \eta' \mathbf{X}_{b,c,t} + \varepsilon_{b,c,t},$$

where b indexes bonds, c counties, s states, r ratings, and t times of issuance in year-months. Local fund measures are based on open-end municipal bond funds located in the same state as the bond's issuer as of the previous month of the offering. *Tax privilege* is the difference between the highest state income tax rates applied to muni bonds issued in other states and those issued in state s. Other variable definitions are in Appendix Table B1. Standard errors are adjusted for clustering by state and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

	(1)	(2)
Has funds$_{s,t-1}$	0.153***	
	(0.022)	
Has funds$_{s,t-1}\times$ Tax privilege (%)$_{s,t}$	−0.025***	
	(0.005)	
Ln(TNA)$_{s,t-1}$		0.096***
		(0.008)
Ln(TNA)$_{s,t-1}\times$ Tax privilege (%)$_{s,t}$		−0.022***
		(0.002)
Tax privilege (%)$_{s,t}$	−0.020***	0.150***
	(0.005)	(0.013)
Ln(Maturity)$_b$	0.231***	0.232***
	(0.004)	(0.005)
Ln(Offering amount)$_b$	−0.009***	−0.010***
	(0.001)	(0.001)
Callable$_b$	0.230***	0.226***
	(0.004)	(0.005)
General obligation bond$_b$	−0.087***	−0.077***
	(0.004)	(0.004)
Bank qualified$_b$	−0.151***	−0.154***
	(0.004)	(0.005)
N	1,008,508	797,608
Adjusted R^2	0.69	0.69
County controls	✓	✓
County FEs	✓	✓
Year–Month FEs	✓	✓
Rating FEs	✓	✓

yields between tax-exempt munis and taxable Treasuries (e.g., Schwert, 2017; Cornaggia, Cornaggia, and Israelsen, 2018). This tax adjustment is more relevant to secondary market trading analyses. Meanwhile, unadjusted yields better reflect the cost of financing for issuers in the primary market. In Internet Appendix Table IA6, I demonstrate that the baseline results in Table 2 still hold when using tax-adjusted yield spread as the dependent variable.

Following Schwert (2017), I define tax-adjusted yield spread as follows:

$$\frac{y_{b,t}}{(1-\tau_t^{fed})(1-\tau_{s,t}^{state})} - r_{b,t}, \tag{11}$$

where τ_t^{fed} and $\tau_{s,t}^{state}$ are the federal and state tax rates, respectively, in the year of the issuance. That is, the offering yield is adjusted to account for the tax exemption at both the federal and state levels if investors invest in muni bonds issued in the same state. Results in Internet Appendix Table IA6, which uses tax-adjusted yield spread as the dependent variable, are consistent with the baseline results. Tax-adjusted yield spreads are higher by 5.9 bps in states with at least one municipal bond funds. Similarly, yield spreads increase by 3.8 bps when the aggregate local fund size doubles but decline by 10.0 bps for every two-fold increase in the number of local funds.

5 Robustness

This section provides additional analyses to ensure that the main results are robust to heterogeneity across bonds, counties, and time periods, as well as to the measurement of *informed investors*.

5.1 Local economic conditions

The model presented in section 2 suggests that the positive relation between having local funds (or their aggregate size) and bond yield spreads is stronger when uncertainty is higher. Intuitively, when the bond offering is associated with higher uncertainty, local funds become relatively more informed than other investors, requiring the bond to be more underpriced so that uninformed investors can break even in expectation. The impact of uncertainty on the second relation between the number of local funds and yield spreads (Hypothesis 2), however, is ambiguous. Since smaller counties are often associated with higher level of information asymmetry and lower attention from the market, I expect local funds to have a stronger effect on yield spreads of bonds issued in smaller counties with weaker economic activity. Results of this analysis are reported in Table 7.

Table 7
Local economic conditions

This table reports results of regressions of a bond's yield spread on measures of local municipal bond funds interacted with county characteristics:

$$\textit{Yield spread (\%)}_b = \alpha_c + \alpha_r + \alpha_t + \beta \times \textit{Local funds}_{s,t-1} \times \textit{County characteristics}_{c,t-1} + \eta' \mathbf{X}_{b,c,t} + \varepsilon_{b,c,t},$$

where b indexes bonds, c counties, s states, r ratings, and t times of issuance in year-months. Local fund measures are based on open-end municipal bond funds located in the same state as the bond's issuer as of the previous month of the offering. Other variable definitions are in Appendix Table B1. Standard errors are adjusted for clustering by state and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

	(1)	(2)	(3)	(4)	(5)	(6)
Ln(TNA)$_{s,t-1}$	0.005	0.043***	0.504***	0.129*	−0.002	0.050***
	(0.007)	(0.010)	(0.056)	(0.076)	(0.006)	(0.009)
Ln(# funds)$_{s,t-1}$		−0.108***		0.767***		−0.124***
		(0.014)		(0.109)		(0.014)
Ln(TNA)$_{s,t-1}\times$ Ln(Population)$_{c,t-1}$	−0.010***	−0.004				
	(0.004)	(0.004)				
Ln(# funds)$_{s,t-1}\times$ Ln(Population)$_{c,t-1}$		−0.023***				
		(0.005)				
Ln(TNA)$_{s,t-1}\times$ Ln(Average wage)$_{c,t-1}$			−0.125***	−0.020		
			(0.014)	(0.019)		
Ln(# funds)$_{s,t-1}\times$ Ln(Average wage)$_{c,t-1}$				−0.220***		
				(0.028)		
Ln(TNA)$_{s,t-1}\times$ Unemployment rate (%)$_{c,t-1}$					0.008***	0.003**
					(0.001)	(0.001)
Ln(# funds)$_{s,t-1}\times$ Unemployment rate (%)$_{c,t-1}$						0.009***
						(0.002)
Ln(Population)$_{c,t-1}$	−0.146	−0.139	−0.313***	−0.362***	−0.288***	−0.313***
	(0.101)	(0.101)	(0.099)	(0.097)	(0.095)	(0.093)
Ln(Average wage)$_{c,t-1}$	0.213***	0.188**	1.421***	1.035***	0.195**	0.146*
	(0.078)	(0.079)	(0.153)	(0.155)	(0.076)	(0.076)
Unemployment rate (%)$_{c,t-1}$	0.041***	0.041***	0.037***	0.036***	−0.037***	−0.020***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.007)
N	797,608	797,608	797,608	797,608	797,608	797,608
Adjusted R^2	0.68	0.68	0.68	0.68	0.68	0.68
Bond controls	✓	✓	✓	✓	✓	✓
Other county controls	✓	✓	✓	✓	✓	✓
County FEs	✓	✓	✓	✓	✓	✓
Year–Month FEs	✓	✓	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓	✓

In Table 7, I include measures of local funds interacted with three county characteristics: log of population, average wage and salary, and unemployment rate. When the county's population doubles, the positive effect of aggregate local fund size on bond yield spreads decreases by 1.0 bps, or 56% of the 1.8 bps baseline estimate in Table 2. The effect is similarly weaker in counties with higher average wages and lower unemployment rates. These results are consistent with the conjecture that local funds have a greater impact on bond underpricing when information is more asymmetric.

In terms of the relation between the number of local funds and bond pricing, I find that the baseline effect in Table 2 is strengthened (more negative) in larger local economies with higher wages and lower unemployment rates. The estimates are economically significant; for example, a two-fold increase in population is associated with a 2.3 bps stronger effect compared to the unconditional estimate of (minus) 6.6 bps in Table 2. Even though not predicted by the model, this finding can be explained by larger counties experiencing higher competition not only among local funds but also from other informed institutional investors, which creates downward pressure on bond yields.

In Table 8, instead of local economic activities, I study how broad market conditions affect the relation between local funds and bond yield spreads. Three proxies for market conditions are used: 1) monthly aggregate outflows from U.S. municipal bond funds; 2) monthly average VIX; and 3) monthly realized return volatility of the Bloomberg Barclays Municipal Bond Index. Results in Table 8 support the conjecture that the positive effect of aggregate local fund size on bond yield is significantly stronger when the market is more stressed and more volatile. On the contrary, the relation between the number of local funds and yield spreads is only significantly sensitive to aggregate outflows but not to the other two market condition measures.

In general, consistent with the model in section 2, results in this section suggest that the effect of local funds, or informed investors, on bond underpricing is stronger in smaller counties and during stressed markets, both of which are associated with high level of information asymmetry.

Table 8
Market conditions

This table reports results of regressions of a bond's yield spread on measures of local municipal bond funds interacted with market conditions measures:

$$\textit{Yield spread (\%)}_b = \alpha_c + \alpha_r + \alpha_t + \beta \times \textit{Local funds}_{s,t-1} \times \textit{Market conditions}_t + \eta' \mathbf{X}_{b,c,t} + \varepsilon_{b,c,t},$$

where b indexes bonds, c counties, s states, r ratings, and t times of issuance in year-months. Local fund measures are based on open-end municipal bond funds located in the same state as the bond's issuer as of the previous month of the offering. *Aggregate outflows* are the monthly aggregate net outflows-to-assets ratio of all U.S. open-end municipal bond funds. *VIX* is the monthly average of the Chicago Board Options Exchange's CBOE Volatility Index. *Market volatility* is the annualized monthly realized volatility of the Bloomberg Barclays Municipal Bond Index. All three measures are standardized to have mean zero and standard deviation of one. Other variable definitions are in Appendix Table B1. Standard errors are adjusted for clustering by state and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

	(1)	(2)	(3)	(4)	(5)	(6)
Ln(TNA)$_{s,t-1}$	0.017***	0.049***	0.022***	0.053***	0.019***	0.048***
	(0.006)	(0.010)	(0.005)	(0.011)	(0.005)	(0.011)
Ln(# funds)$_{s,t-1}$		−0.069***		−0.068***		−0.067***
		(0.012)		(0.012)		(0.012)
Ln(TNA)$_{s,t-1}\times$ Aggregate outflows$_t$	0.003**	−0.006***				
	(0.001)	(0.002)				
Ln(# funds)$_{s,t-1}\times$ Aggregate outflows$_t$		0.016***				
		(0.003)				
Ln(TNA)$_{s,t-1}\times$ VIX$_t$			0.004***	0.007**		
			(0.001)	(0.003)		
Ln(# funds)$_{s,t-1}\times$ VIX$_t$				−0.006		
				(0.005)		
Ln(TNA)$_{s,t-1}\times$ Market volatility$_t$					0.002**	0.001
					(0.001)	(0.002)
Ln(# funds)$_{s,t-1}\times$ Market volatility$_t$						0.002
						(0.003)
N	797,608	797,608	797,608	797,608	797,608	797,608
Adjusted R^2	0.68	0.68	0.68	0.68	0.68	0.68
Bond controls	✓	✓	✓	✓	✓	✓
County controls	✓	✓	✓	✓	✓	✓
County FEs	✓	✓	✓	✓	✓	✓
Year–Month FEs	✓	✓	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓	✓

5.2 Bond sample splits

Similar to the analysis in the previous section, Internet Appendix Table IA7 shows the robustness of main results with regard to different bond characteristics. Results in Table 2 are replicated using subsamples based on a vector of bond characteristics, with coefficient estimates in columns 1, 2, and 4 being reported. Row 1 reports the baseline results from Table 2. Rows 2–3 examine high-rated bonds with rating AA- to AAA and lower-rated bonds, respectively. Rows 4–7 split the sample into subsamples based on the median value of offering amount and years to maturity. Similarly, rows 8–13 split the sample based on whether the bond is callable, general obligation, and bank qualified.

The main results in Table 2 remain significant in almost all subsamples. Regardless of bond characteristics, yield spreads are higher when the state has at least one muni fund, when the aggregate local fund size is larger, and when there are fewer local funds. There is further evidence that the positive relation between the existence of local funds (or their aggregate TNA) and bond yield spreads from Hypothesis 1 is stronger for bonds associated with higher uncertainty, such as smaller bonds with lower credit ratings. Overall, Table IA7 provides additional support for the main results documented in the previous tables.

5.3 Fund families

The main results in this paper treat local muni funds as individual informed investors. One question that may arise is whether mutual funds within a fund family share information or are managed by the same manager, which could violate the assumption of independent (or more generally, not perfectly correlated) signals in the model presented in section 2. To address this concern, Internet Appendix Table IA3 reports results using measures of local fund families in terms of average family size, the number of local families, and their HHI. The other measures, the indicator that a state has at least one fund (family) and the aggregate local fund (family) size, are identical regardless of whether the unit of observations is a fund or a family.

Consistent with Table 2, Table IA3 indicates that bond yield spreads increase in the average family size and HHI, and decrease in the number of local families in a state. Specifically, when the average family size (the number of local families) doubles, yield spreads increase (decrease) by 7.1 bps on average. Similarly, bond yields are 17.8 bps higher for every two-fold increase in local family concentration level. These results also hold using measures of distance-adjusted fund families, as reported in columns 4–5. Table IA3 then indicates that the main implications of my model are consistently supported by analyses that use different measures for local informed investors.

5.4 Sample selection bias

The sample used in this study consists of actual bond issues, which raises the possibility that some local issuers may choose not to issue bonds if the market conditions are unfavorable, such as during periods of high financing costs. To address this potential bias, I employ the sample selection model by Heckman (1979) and re-estimate the baseline results. Results of this analysis are presented in Internet Appendix Table IA8.

Panel A of Table IA8 reports the first-stage probit result of how bond issuance propensity can be predicted by county characteristics. Larger counties, in terms of either GDP or population, and counties with younger and more highly educated population are more likely to issue bonds. This suggests that counties with higher demand for infrastructure spending and investment are more likely to raise funding from the municipal bond market. In contrast, bond issuance propensity is lower in wealthier counties with higher income and housing values, likely due to higher tax revenue reducing the need for public financing.

Panel B then re-estimates the results of Table 2 with inverse Mills ratio (λ) included. All main coefficient estimates remain statistically significant, and their magnitudes are largely unchanged, confirming that the baseline results regarding the impact of local funds on bond financing costs are not susceptible to potential sample selection bias.

6 Conclusion

This paper examines the impact of local municipal bond funds on bond offerings, both theoretically and empirically, within the context of the high level of information asymmetry in the municipal bond markets. The theoretical framework predicts that the potential participation of informed investors requires the issuer to set a higher offering yield to compensate uninformed investors for their winner's curse. Empirically, the study finds that bond yield spreads are higher in states with municipal bond funds and when the aggregate size of local funds is larger. This relation is stronger when local funds have higher investment propensity, when the local county is smaller with weaker economic activity during volatile markets, and for bonds associated with higher uncertainty. Conditional on having local funds and keeping aggregate fund size constant, I however document a negative relation between yield spreads and the number of local funds, which can be attributed to information dispersion across these local *informed investors*.

The higher yield spreads associated with mutual funds indicate higher financing costs for local issuers, potentially impacting the long-term growth and sustainability of the local economy. There are nevertheless potential positive effects of local mutual funds on the local economy, including job creation, increased tax revenues, and enhanced wealth for local residents. There are therefore costs and benefits associated with municipal bond funds to the local economy, warranting further investigation in future research.

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Appendix A: Proofs

This section shows that, in general case with N imperfectly informed investors, the offering price $\hat{p}_N$ increases in N, given $N \geq 1$. Recall from Equation 8 that the offering price in equilibrium is:

$$\hat{p}_N = \frac{1}{1 + \sqrt{\frac{U+I}{U} M}} V,$$

where $M = \sum_{k=0}^{N} \binom{N}{k} \pi^k (1-\pi)^{N-k} \frac{U}{U + \frac{N-k}{N} I}$. Set $\alpha = \frac{I}{U+I} \in [0, 1]$, M becomes:

$$M = (1-\alpha) \sum_{k=0}^{N} \binom{N}{k} \pi^k (1-\pi)^{N-k} \frac{1}{1 - \frac{\alpha}{N} k} = (1-\alpha) \mathbb{E}\left[\frac{1}{1 - \frac{\alpha}{N} X}\right], \tag{A1}$$

where $X \sim B(N, \pi)$. It then suffices to show that $\mathbb{E}\left[\frac{1}{1 - \frac{\alpha}{N} X}\right]$ decreases in N.

Another way to express $\mathbb{E}\left[\frac{1}{1 - \frac{\alpha}{N} X}\right]$ is

$$\begin{aligned}
\mathbb{E}\left[\frac{1}{1 - \frac{\alpha}{N} X}\right] &= \sum_{k=0}^{N} \binom{N}{k} \pi^k (1-\pi)^{N-k} \int_0^1 s^{-\alpha k / N} \, ds = \int_0^1 \sum_{k=0}^{N} \binom{N}{k} (\pi s^{-\alpha/N})^k (1-\pi)^{N-k} \, ds \\
&= \int_0^1 (1 - \pi + \pi s^{-\alpha/N})^N \, ds = \int_0^1 s^{-\alpha \Lambda(\pi, \kappa)} \, ds,
\end{aligned} \tag{A2}$$

where $\Lambda(\pi, \kappa) = \frac{\ln(1 + \pi\kappa)}{\ln(1+\kappa)}$ for $\kappa = s^{-\alpha/N} - 1 > 0$. Since κ increases in N, to complete the proof we need to show $\Lambda(\pi, \kappa)$ increases in κ. Taking the derivative of Λ with respect to κ yields:

$$\frac{\Lambda_\kappa(\pi, \kappa)}{\Lambda(\pi, \kappa)} = \frac{\pi}{(1 + \pi\kappa) \ln(1 + \pi\kappa)} - \frac{1}{(1+\kappa) \ln(1+\kappa)} = \frac{f(\pi\kappa) - f(\kappa)}{\kappa}, \tag{A3}$$

where $f(x) = \frac{x}{(1+x)\ln(1+x)}$, which decreases in $(0; \infty)$ since

$$f_x = \frac{\ln(1+x) - x}{[(1+x)\ln(1+x)]^2} < 0 \text{ for } x > 0$$

Therefore, we have $f(\pi\kappa) > f(\kappa)$ for $\kappa > 0$ and π in $[0, 1)$. Equation A3 then suggests that $\Lambda(\pi, \kappa)$ increases in κ. Equivalently, M decreases in N and $\hat{p}_N$ increases in N. $\square$

Appendix B: Variable Definitions

Table B1
Variable definitions

Variable	Definition
Local fund measures	
Has funds$_{s,t-1}$	Indicator of whether there is at least one open-end municipal bond fund located in state s as of month $t-1$.
# funds$_{s,t-1}$	Number of open-end municipal bond funds located in state s as of month $t-1$.
Aggregate TNA$_{s,t-1}$	Aggregate total net assets (TNA) of all open-end municipal bond funds located in state s as of month $t-1$, in $ millions.
HHI TNA$_{s,t-1}$	Herfindahl–Hirschman index of TNA of open-end municipal bond funds located in state s as of month $t-1$.
Cash/TNA$_{s,t-1}$	A fund's cash-to-assets ratio is the ratio of the fund's cash & cash equivalents to its TNA. Cash/TNA$_{s,t-1}$ is the TNA-weighted average of local funds' cash-to-assets ratios as of month $t-1$.
Abnormal fund return$_{s,t-1}$	Local funds' abnormal returns as of month $t-1$, in %, estimated from the twelve-month rolling window regressions of monthly fund returns on market factors: 1) aggregate bond factor—Bloomberg Barclays U.S. Aggregate Bond Index return in excess of risk-free rate; 2) muni bond factor—the difference between U.S. Municipal Index return and U.S. Aggregate Bond Index return; 3) high yield factor—the difference between U.S. High Yield Municipal Bond Index return and U.S. Municipal Index return; 4) term structure factor—the difference between U.S. Municipal Index return and U.S. Government/Credit 1-3 Year Index return; and 5) Fama-French stock market excess return.
Average distance$_{c,t-1}$	Average distance between county c and headquarters of all U.S. open-end municipal bond funds as of month $t-1$, in thousand miles.
Average family TNA$_{s,t-1}$	Average TNA, restricted to open-end municipal bond funds, of all fund families located in state s as of month $t-1$, in $ millions. Only families with at least one open-end municipal bond fund are included in the calculation.
# families$_{s,t-1}$	Number of fund families with at least one open-end municipal bond fund located in state s as of month $t-1$.
HHI family TNA$_{s,t-1}$	Herfindahl–Hirschman index of TNA, at the family level, of open-end municipal bond funds located in state s as of month $t-1$.
Bond characteristics	
Held by local funds$_{b,3m}$	Indicator of whether bond b is held by at least one local fund within three months of the offering date.
Local fund holding$_{b,3m}$	Local funds' holding of bond b within three months of the offering date, in % of bond b's offering amount.

(Continued)

Table B1—*Continued*

Variable	Definition
# local holding funds$_{b,3m}$	Number of local funds holding bond b within three months of the offering date.
Few local holding funds$_{b,3m}$	Indicator of whether bond b is held by at most one local fund within three months of the offering date.
Offering yield$_b$	Bond b's offering yield, in %.
Yield spread$_b$	The difference between bond b's offering yield and the hypothetical yield of a risk-free bond with similar payment structure, calculated using Treasury rates, in %. In the calculation of tax-adjusted yield spread, the offering yield is multiplied by $\frac{1}{(1-\tau_t^{fed})(1-\tau_{s,t}^{state})}$.
Maturity$_b$	Bond b's number of years to maturity.
Offering amount$_b$	Bond b's offering amount, in \$ millions.
Callable$_b$	Indicator of whether bond b is callable.
General obligation bond$_b$	Indicator of whether bond b is general obligation bond.
Bank qualified$_b$	Indicator of whether bond b is bank qualified.
Rating$_b$	Bond b's rating at issuance—the median of Moody's, S&P, and Fitch ratings when all are available, or lower rating otherwise. Bond ratings are encoded so that AAA = 0, AA+ = 1, ..., BB+ = 10, ..., C = 20.
High yield$_b$	Indicator of whether bond b is high yield.
County characteristics	
GDP$_{c,t-1}$	County c's GDP as of year $t-1$, in \$billions.
Population$_{c,t-1}$	County c's population as of year $t-1$, in millions.
Average wage$_{c,t-1}$	County c's average wage and salaries as of year $t-1$, in \$000s.
House value$_{c,t-1}$	County c's median house value as of year $t-1$, in \$000s.
Unemployment rate$_{c,t-1}$	County c's unemployment rate as of year $t-1$, in %.
Median age$_{c,t-1}$	County c's median age as of year $t-1$.
High school graduate$_{c,t-1}$	County c's population with at least high school diploma as of year $t-1$, in %.
Tax privilege$_{s,t}$	The difference between the highest state income tax rates applied to municipal bonds issued in other states and those issued in state s as of year t, in %.
Market conditions	
Aggregate outflows$_t$	Monthly aggregate net outflow-to-assets ratio of U.S. open-end municipal bond funds.
VIX$_t$	Monthly average of the Chicago Board Options Exchange's CBOE Volatility Index.
Market volatility$_t$	Annualized monthly realized volatility of the Bloomberg Barclays Municipal Bond Index.

Internet Appendix for “Informed Investors and Underpricing in Municipal Bond Offerings”

This Internet Appendix reports the following additional results.

1. Figure IA1 plots the 25th, 50th, and 75th percentiles of municipal bond issues' yield spreads between January 2009 and December 2019.
2. Figure IA2 plots the number of open-end municipal bond funds, and their aggregate TNA, in the United States between January 2009 and December 2019.
3. Table IA1 reports the number of open-end municipal bond funds, and their aggregate TNA, in each state as of the end of each year between 2009 and 2019.
4. Table IA2 reports the association between yield spreads and measures of distance-adjusted municipal bond funds.
5. Table IA3 reports the association between yield spreads and measures of local municipal bond fund families.
6. Table IA4 reports the statistics of the value-weighted average characteristics of bonds held by local funds across states and over time.
7. Table IA5 reports the first stage of the instrumental variables analysis in Table 3.
8. Table IA6 shows that the baseline results are robust to using tax-adjusted yield spreads.
9. Table IA7 shows that the baseline results are robust to different bond characteristics.
10. Table IA8 shows that the baseline results are robust to correcting for sample selection bias, following Heckman (1979).

Figure IA1
Yield spreads over time

This figure reports the monthly statistics of municipal bonds' yield spreads between 2009 and 2019. The calculation relies on bonds that are fixed-rate or zero-coupon, are tax-exempt, and have an offering amount of at least $100,000.

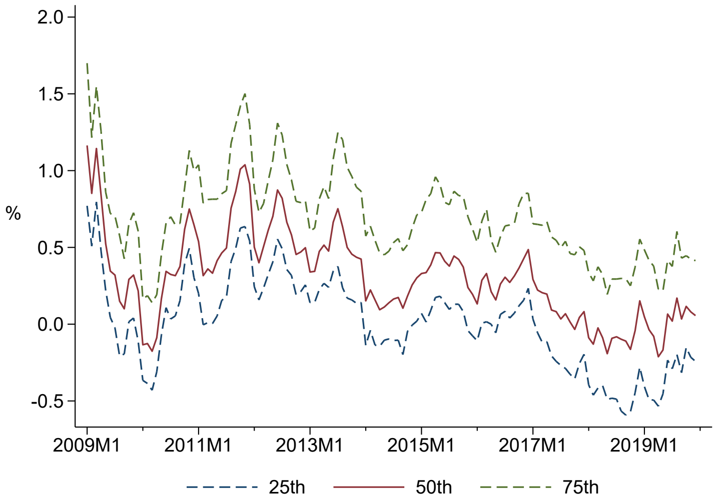

Figure IA2
Open-end municipal bond funds over time

This figure reports the number of open-end municipal bond funds and their aggregate TNA between 2009 and 2019.

(a) Number of funds

(b) TNA, in $ billions

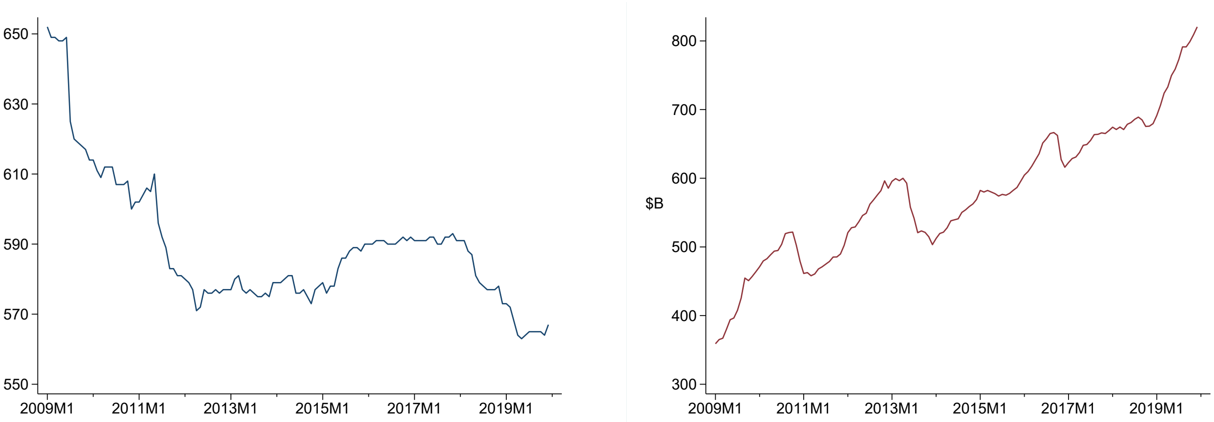

Table IA1
Open-end municipal bond funds over time

This table reports the number of open-end municipal bond mutual funds and their aggregate TNA (in $ millions) in each state as of the end of each year between 2009 and 2019. Alaska, Alabama, Arkansas, Idaho, Louisiana, Mississippi, Montana, New Hampshire, Nevada, Oklahoma, Oregon, Rhode Island, South Carolina, South Dakota, Utah, Virginia, and Wyoming are not reported as there were no funds located in those states at any time during the sample period.

State		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Arizona	*# funds*	-	-	1	1	1	1	1	1	1	1	1
	TNA	-	-	4.03	3.85	1.34	1.20	1.18	0.90	0.81	0.78	0.69
California	*# funds*	70	74	71	76	76	74	74	69	69	71	70
	TNA	99,044.44	103,919.30	107,839.86	126,107.61	106,421.55	115,736.59	116,943.73	117,255.72	119,373.47	114,981.11	130,369.19
Colorado	*# funds*	21	23	22	23	23	26	26	27	27	20	18
	TNA	29,737.38	29,618.59	29,025.31	37,355.53	27,904.49	27,664.68	25,394.73	25,301.68	23,679.65	23,853.28	27,855.97
Connecticut	*# funds*	7	6	6	6	3	3	3	2	2	4	3
	TNA	2,525.43	2,375.22	2,563.01	2,956.16	2,065.23	2,382.91	2,625.08	1,154.60	1,308.05	2,548.41	1,324.70
District of Columbia	*# funds*	2	2	2	-	-	-	-	-	1	1	1
	TNA	830.51	821.80	819.91	-	-	-	-	-	144.52	146.32	185.13
Delaware	*# funds*	16	14	12	11	11	12	12	12	12	14	14
	TNA	6,405.87	6,653.52	7,604.07	9,558.05	7,944.43	10,934.79	13,839.43	15,502.92	20,010.07	25,207.01	35,175.79
Florida	*# funds*	-	-	-	1	2	-	-	-	-	-	-
	TNA	-	-	-	6.46	24.44	-	-	-	-	-	-
Georgia	*# funds*	1	1	-	-	-	-	-	-	-	-	-
	TNA	38.83	9.37	-	-	-	-	-	-	-	-	-
Hawaii	*# funds*	1	1	1	1	1	1	1	1	1	1	1
	TNA	165.52	169.17	160.29	174.88	157.97	170.24	164.53	167.94	165.06	161.66	164.83
Iowa	*# funds*	4	2	2	3	3	3	3	3	3	3	3
	TNA	637.05	489.70	455.62	526.46	392.30	475.44	609.95	876.33	901.28	892.50	1,371.02
Illinois	*# funds*	44	44	54	45	46	48	48	49	49	49	48
	TNA	28,035.26	29,927.87	34,190.68	43,662.32	38,191.37	48,457.33	52,259.09	55,276.10	64,407.48	70,907.69	97,193.70
Indiana	*# funds*	1	1	1	1	1	-	-	-	-	-	-
	TNA	45.32	52.04	53.76	54.04	27.58	-	-	-	-	-	-
Kansas	*# funds*	4	4	4	4	4	4	4	5	4	3	3
	TNA	1,268.16	1,790.79	2,391.03	3,592.46	2,798.41	3,231.39	3,296.93	3,006.35	2,460.36	2,037.03	1,975.87
Kentucky	*# funds*	8	9	9	9	9	9	9	9	9	9	9
	TNA	1,102.89	1,148.04	1,286.90	1,384.15	1,276.23	1,370.86	1,404.83	1,391.48	1,378.40	1,286.10	1,357.18
Massachusetts	*# funds*	138	129	131	132	133	127	128	131	132	120	118
	TNA	71,847.62	68,630.53	74,292.10	83,409.07	67,292.25	74,028.00	76,595.29	79,387.78	83,554.21	76,579.91	92,533.00
Maryland	*# funds*	20	20	26	25	25	24	23	23	22	18	17

(Continued)

Table IA1—*continued*

State		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	TNA	11,616.35	13,227.31	14,560.59	17,095.71	15,889.70	19,037.79	19,430.63	21,082.87	24,048.13	23,036.02	26,513.74
Maine	# *funds*	-	-	-	-	-	2	5	5	5	5	5
	TNA	-	-	-	-	-	141.45	423.45	630.67	710.37	700.62	780.25
Michigan	# *funds*	1	1	-	-	-	-	-	-	-	-	-
	TNA	75.66	79.49	-	-	-	-	-	-	-	-	-
Minnesota	# *funds*	27	26	3	3	3	3	3	3	3	4	4
	TNA	8,781.82	8,537.29	1,924.76	2,204.82	1,934.47	2,139.70	2,222.17	2,264.32	2,334.65	2,272.62	2,564.01
Missouri	# *funds*	10	10	10	10	9	9	9	8	7	8	8
	TNA	4,105.46	4,543.24	5,985.99	7,553.20	6,481.35	7,005.18	7,477.37	7,362.30	7,819.26	12,236.88	15,771.77
North Carolina	# *funds*	6	6	6	7	7	7	6	6	6	6	6
	TNA	434.39	517.55	575.19	687.54	564.88	548.02	536.60	526.84	490.98	411.71	448.39
North Dakota	# *funds*	8	8	8	7	7	7	7	7	7	6	6
	TNA	202.48	215.78	242.84	291.36	253.33	255.31	261.73	285.47	277.33	248.17	290.91
Nebraska	# *funds*	1	1	1	1	1	1	1	3	4	2	3
	TNA	77.00	90.00	90.96	103.79	70.04	70.12	63.56	227.85	255.02	112.27	107.34
New Jersey	# *funds*	16	12	11	11	11	12	13	13	13	13	12
	TNA	8,118.80	9,442.48	10,158.79	13,795.27	10,891.24	12,119.44	12,663.46	13,021.87	13,244.96	12,437.04	16,805.25
New Mexico	# *funds*	6	6	6	6	7	7	7	7	7	7	7
	TNA	3,610.52	5,334.73	6,304.78	8,271.48	8,487.47	9,674.90	10,046.30	10,005.05	9,656.65	8,584.52	8,136.81
New York	# *funds*	112	116	112	113	113	112	112	113	110	101	101
	TNA	67,100.62	72,145.55	72,648.36	79,874.88	68,301.51	74,254.01	75,556.39	76,236.37	80,875.26	78,780.39	91,741.14
Ohio	# *funds*	16	14	8	8	8	8	9	11	10	10	11
	TNA	1,259.16	1,266.00	983.30	1,163.29	718.20	676.03	624.93	673.12	516.90	598.76	1,236.75
Pennsylvania	# *funds*	38	38	39	39	41	41	44	42	42	53	53
	TNA	92,860.88	95,329.55	102,893.11	116,204.39	108,636.26	126,974.55	137,402.31	145,653.59	166,885.53	179,094.66	217,177.55
Tennessee	# *funds*	1	-	-	-	-	-	-	-	-	-	-
	TNA	16.66	-	-	-	-	-	-	-	-	-	-
Texas	# *funds*	22	22	23	22	20	21	23	23	25	25	26
	TNA	19,994.56	19,704.35	22,001.96	25,004.63	22,356.33	26,171.91	28,209.62	30,435.49	34,439.00	33,846.04	38,459.22
Vermont	# *funds*	1	1	1	1	1	1	-	-	-	-	-
	TNA	27.48	24.37	21.51	17.38	13.90	11.71	-	-	-	-	-
Washington	# *funds*	2	2	2	2	2	2	3	3	3	3	3
	TNA	488.17	559.89	637.66	733.37	916.96	1,341.05	1,643.54	1,805.80	2,618.20	3,222.78	4,079.41
Wisconsin	# *funds*	9	8	8	8	10	12	15	15	16	15	15
	TNA	3,385.98	2,487.37	2,501.84	3,642.91	3,177.32	4,051.90	5,733.44	6,395.39	7,772.58	5,291.27	6,734.55
West Virginia	# *funds*	1	1	1	1	1	1	1	1	1	1	1
	TNA	85.57	86.58	98.59	114.18	110.57	120.97	118.41	118.13	116.11	114.39	117.95

Table IA2
Yield spreads and distance-adjusted mutual funds

This table reports results of regressions of a bond's yield spread on measures of distance-adjusted municipal bond funds:

$$\textit{Yield spread (\%)}_b = \alpha_c + \alpha_r + \alpha_t + \beta \times \textit{Distance-adjusted funds}_{c,t-1} + \eta' \mathbf{X}_{b,c,t} + \varepsilon_{b,c,t},$$

where b indexes bonds, c counties, s states, r ratings, and t times of issuance in year-months. Adjusted local fund measures are based on all U.S. open-end municipal bond funds, with fund size being discounted by the square root of distance between the bond's and the fund's counties. Other variable definitions are in Appendix Table B1. Standard errors are adjusted for clustering by state and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

				EW distance	VW distance
	(1)	(2)	(3)	(4)	(5)
Ln(Adjusted TNA)$_{c,t-1}$	0.331***		−0.199***	0.392***	0.018
	(0.053)		(0.069)	(0.053)	(0.050)
Adjusted TNA per capita$_{c,t-1}$		0.267***			
		(0.029)			
Ln(HHI adj. TNA)$_{c,t-1}$			0.368***		
			(0.042)		
Average distance$_{c,t-1}$				2.243***	−1.164***
				(0.429)	(0.110)
Ln(Maturity)$_b$	0.231***	0.232***	0.231***	0.231***	0.231***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Ln(Offering amount)$_b$	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Callable$_b$	0.230***	0.229***	0.230***	0.230***	0.230***
	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)
General obligation bond$_b$	−0.088***	−0.088***	−0.088***	−0.088***	−0.087***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Bank qualified$_b$	−0.151***	−0.151***	−0.151***	−0.151***	−0.151***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Ln(GDP)$_{c,t-1}$	−0.125***	−0.108***	−0.113***	−0.151***	−0.125***
	(0.021)	(0.021)	(0.021)	(0.022)	(0.021)
Ln(Population)$_{c,t-1}$	−0.243***	−0.027	−0.047	−0.024	−0.076
	(0.073)	(0.081)	(0.068)	(0.068)	(0.072)
Ln(Average wage)$_{c,t-1}$	0.255***	0.180***	0.201***	0.296***	0.316***
	(0.066)	(0.067)	(0.066)	(0.066)	(0.066)
Ln(House value)$_{c,t-1}$	0.270***	0.198***	0.229***	0.208***	0.351***
	(0.050)	(0.051)	(0.044)	(0.042)	(0.047)
Unemployment rate (%)$_{c,t-1}$	0.036***	0.037***	0.034***	0.036***	0.030***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Median age$_{c,t-1}$	−0.001	0.000	−0.001	0.001	0.006**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
High school graduate (%)$_{c,t-1}$	0.000	−0.000	0.002	0.002	−0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
N	1,008,508	1,008,508	1,008,508	1,008,508	1,008,508
Adjusted R^2	0.68	0.69	0.69	0.69	0.69
County FEs	✓	✓	✓	✓	✓
Year–Month FEs	✓	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓

Table IA3
Yield spreads and local mutual fund families

This table reports results of regressions of a bond's yield spread on measures of local municipal bond fund families:

$$\textit{Yield spread (\%)}_b = \alpha_c + \alpha_r + \alpha_t + \beta \times \textit{Local families}_{s,t-1} + \eta' \mathbf{X}_{b,c,t} + \varepsilon_{b,c,t},$$

where b indexes bonds, c counties, s states, r ratings, and t times of issuance in year-months. Local family measures are based on open-end municipal fund families located in the same state as the bond's issuer as of the previous month of the offering. Adjusted local family measures are based on all U.S. open-end municipal bond fund families, with family size being discounted by the square root of distance between the bond's and the family's counties. Other variable definitions are in Appendix Table B1. Standard errors are adjusted for clustering by state and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

	Same-state families			Distance-adjusted families	
	(1)	(2)	(3)	(4)	(5)
Ln(Average family TNA)$_{s,t-1}$	0.071***			0.331***	
	(0.013)			(0.053)	
Ln(# families)$_{s,t-1}$		−0.071***			
		(0.013)			
Ln(HHI family TNA)$_{s,t-1}$			0.178***		0.532***
			(0.018)		(0.041)
Ln(TNA)$_{s,t-1}$	−0.039***	0.033***	0.035***		−0.421***
	(0.012)	(0.007)	(0.007)		(0.066)
Ln(Maturity)$_b$	0.234***	0.234***	0.234***	0.231***	0.231***
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
Ln(Offering amount)$_b$	−0.010***	−0.010***	−0.010***	−0.009***	−0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Callable$_b$	0.223***	0.223***	0.223***	0.230***	0.230***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.004)
General obligation bond$_b$	−0.079***	−0.079***	−0.079***	−0.088***	−0.087***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Bank qualified$_b$	−0.154***	−0.154***	−0.154***	−0.151***	−0.151***
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
Ln(GDP)$_{c,t-1}$	−0.140***	−0.140***	−0.148***	−0.125***	−0.141***
	(0.026)	(0.026)	(0.026)	(0.021)	(0.021)
Ln(Population)$_{c,t-1}$	−0.317***	−0.317***	−0.179*	−0.243***	0.124*
	(0.101)	(0.101)	(0.093)	(0.073)	(0.070)
Ln(Average wage)$_{c,t-1}$	0.230***	0.230***	0.230***	0.255***	0.239***
	(0.078)	(0.078)	(0.077)	(0.066)	(0.067)
Ln(House value)$_{c,t-1}$	0.215***	0.215***	0.224***	0.270***	0.321***
	(0.067)	(0.067)	(0.064)	(0.050)	(0.045)
Unemployment rate (%)$_{c,t-1}$	0.040***	0.040***	0.040***	0.036***	0.029***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Median age$_{c,t-1}$	0.001	0.001	0.001	−0.001	0.002
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
High school graduate (%)$_{c,t-1}$	−0.005*	−0.005*	−0.004	0.000	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
N	797,608	797,608	797,608	1,008,508	1,008,508
Adjusted R^2	0.68	0.68	0.68	0.68	0.69
County controls	✓	✓	✓	✓	✓
County FEs	✓	✓	✓	✓	✓
Year–Month FEs	✓	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓

Table IA4
Summary statistics: State-level fund holding characteristics

This table reports summary statistics of the value-weighted characteristics of municipal bonds held by mutual funds located in a given state. Only states with at least one open-end municipal bond fund during the sample period are included. The sample period is 2009–2019.

				Percentile		
	N	Mean	SD	25th	50th	75th
Panel A: Cross-sectional statistics of time-series averages						
Average original maturity (years)	34	17.69	4.05	14.39	18.27	20.11
Average offering amount ($m)	34	62.40	44.64	14.37	65.68	93.33
Callable bond share	34	0.70	0.17	0.56	0.71	0.82
General obligation bond share	34	0.23	0.14	0.16	0.20	0.25
Bank qualified bond share	34	0.03	0.04	0.00	0.01	0.04
High yield bond share	34	0.08	0.14	0.00	0.01	0.09
Panel B: Time-series statistics of cross-sectional averages						
Average original maturity (years)	132	18.25	0.46	17.86	18.22	18.56
Average offering amount ($m)	132	71.68	9.46	66.17	70.58	77.67
Callable bond share	132	0.72	0.02	0.70	0.71	0.73
General obligation bond share	132	0.20	0.01	0.19	0.20	0.21
Bank qualified bond share	132	0.03	0.01	0.03	0.03	0.03
High yield bond share	132	0.11	0.02	0.09	0.11	0.12

Table IA5
Instrumental variable analysis: first stage

This table reports first-stage results of instrumental variable regressions of a bond's local holding measures on the absolute differences between the new issue and bonds held by local funds with respect to offering amount, maturity, callability, general obligation versus revenue bond, bank qualification, and high yield versus investment grade rating:

$$\textit{Local holding}_{b,3m} = \alpha_c + \alpha_r + \alpha_t + \beta \times |\Delta \textit{Bond characteristics}|_{b,3m} + \eta' \mathbf{X}_{b,c,t} + \varepsilon_{b,c,t},$$

where b indexes bonds, c counties, s states, r ratings, and t times of issuance in year-months. *Held by local funds* = 1 if the bond is held by at least one local open-end municipal bond fund within three months of the offering date and 0 otherwise. *Local fund holding/Offering amount* is the ratio of all local funds' holding of the bond, within three months of the offering date, to the bond's offering amount. *# local holding funds* is the number of local funds that hold the bond within three months of the offering date. Other variable definitions are in Appendix Table B1. Standard errors are adjusted for clustering by state and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

Dependent variable =	$\mathbb{1}_{\text{Held by local funds}}$ (1)	$\frac{\text{Local fund holding}}{\text{Offering amount}}$ (%) (2)	Ln(1 + # local holding funds) (3)
$\text{Ln}(\lvert\Delta \text{ Maturity}\rvert)_{b,3m}$	−0.000	−0.043***	0.000
	(0.000)	(0.010)	(0.000)
$\text{Ln}(\lvert\Delta \text{ Offering amount}\rvert)_{b,3m}$	−0.014***	−0.108***	−0.014***
	(0.001)	(0.024)	(0.001)
$\lvert\Delta \text{ Callable}\rvert_{b,3m}$	−0.007***	−0.183***	−0.005***
	(0.002)	(0.050)	(0.002)
$\lvert\Delta \text{ GO bond}\rvert_{b,3m}$	−0.017***	−0.254***	−0.014***
	(0.005)	(0.094)	(0.004)
$\lvert\Delta \text{ Bank qualified}\rvert_{b,3m}$	−0.149***	−3.199***	−0.123***
	(0.018)	(0.416)	(0.014)
$\lvert\Delta \text{ High yield}\rvert_{b,3m}$	−0.029**	−0.791***	−0.017
	(0.013)	(0.275)	(0.011)
Ln(Maturity)_b	0.006***	0.116***	0.006***
	(0.001)	(0.014)	(0.001)
$\text{Ln(Offering amount)}_b$	0.024***	0.393***	0.021***
	(0.001)	(0.014)	(0.001)
Callable_b	−0.008***	−0.179***	−0.005***
	(0.001)	(0.030)	(0.001)
$\text{General obligation bond}_b$	−0.006*	−0.174***	−0.004
	(0.003)	(0.063)	(0.002)
Bank qualified_b	0.153***	3.150***	0.129***
	(0.018)	(0.398)	(0.014)
$\text{Ln(GDP)}_{c,t-1}$	0.004	0.018	0.005
	(0.004)	(0.096)	(0.003)
$\text{Ln(Population)}_{c,t-1}$	−0.032**	−0.682**	−0.024*
	(0.015)	(0.342)	(0.013)
$\text{Ln(Average wage)}_{c,t-1}$	−0.030**	−0.414	−0.031**
	(0.015)	(0.341)	(0.012)
$\text{Ln(House value)}_{c,t-1}$	0.000	−0.005	0.001
	(0.010)	(0.217)	(0.008)
$\text{Unemployment rate (\%)}_{c,t-1}$	0.002***	0.046***	0.001***
	(0.000)	(0.011)	(0.000)
$\text{Median age}_{c,t-1}$	−0.002***	−0.037**	−0.002**
	(0.001)	(0.018)	(0.001)
$\text{High school graduate (\%)}_{c,t-1}$	−0.000	−0.007	−0.000
	(0.001)	(0.016)	(0.001)
N	794,898	794,898	794,898
Adjusted R^2	0.11	0.09	0.12
County FEs	✓	✓	✓
Year–Month FEs	✓	✓	✓
Rating FEs	✓	✓	✓

Table IA6
Tax-adjusted yield spreads

This table reports results of regressions of a bond's tax-adjusted yield spread on measures of local municipal bond funds:

$$\textit{Tax-adjusted yield spread (\%)}_b = \alpha_c + \alpha_r + \alpha_t + \beta \times \textit{Local funds}_{s,t-1} + \eta' \mathbf{X}_{b,c,t} + \varepsilon_{b,c,t},$$

where b indexes bonds, c counties, s states, r ratings, and t times of issuance in year-months. Local fund measures are based on open-end municipal bond funds located in the same state as the bond's issuer as of the previous month of the offering. *Tax-adjusted yield spread* is the difference between the bond's offering yield, adjusted for federal and state taxes, and a risk-free yield imputed from the bond's payment schedule and the Treasury yield curve as of the bond's offering date. Other variable definitions are in Appendix Table B1. In columns 2, 4, and 5, the sample is restricted to bond issues in states with at least one open-end municipal bond fund. Standard errors are adjusted for clustering by state and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

	(1)	(2)	(3)	(4)	(5)
Has funds$_{s,t-1}$	0.059***				
	(0.020)				
Ln(TNA)$_{s,t-1}$		0.038***		0.080***	0.062***
		(0.010)		(0.019)	(0.014)
TNA per capita$_{c,t-1}$			0.202***		
			(0.041)		
Ln(# funds)$_{s,t-1}$				−0.100***	
				(0.022)	
Ln(HHI TNA)$_{s,t-1}$					0.096***
					(0.027)
Ln(Maturity)$_b$	0.941***	0.951***	0.941***	0.951***	0.951***
	(0.007)	(0.009)	(0.007)	(0.009)	(0.009)
Ln(Offering amount)$_b$	−0.026***	−0.028***	−0.026***	−0.028***	−0.028***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Callable$_b$	0.404***	0.397***	0.404***	0.397***	0.397***
	(0.007)	(0.009)	(0.007)	(0.009)	(0.009)
General obligation bond$_b$	−0.146***	−0.133***	−0.146***	−0.133***	−0.133***
	(0.006)	(0.007)	(0.006)	(0.007)	(0.007)
Bank qualified$_b$	−0.265***	−0.269***	−0.264***	−0.269***	−0.269***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)
Ln(GDP)$_{c,t-1}$	−0.243***	−0.290***	−0.236***	−0.279***	−0.292***
	(0.036)	(0.044)	(0.036)	(0.044)	(0.044)
Ln(Population)$_{c,t-1}$	−0.417***	−0.338**	−0.317**	−0.315*	−0.273*
	(0.129)	(0.170)	(0.132)	(0.169)	(0.163)
Ln(Average wage)$_{c,t-1}$	0.537***	0.580***	0.525***	0.538***	0.558***
	(0.116)	(0.136)	(0.116)	(0.137)	(0.137)
Ln(House value)$_{c,t-1}$	0.261***	0.109	0.224***	0.131	0.102
	(0.086)	(0.115)	(0.087)	(0.115)	(0.113)
Unemployment rate (%)$_{c,t-1}$	0.059***	0.068***	0.059***	0.068***	0.069***
	(0.004)	(0.006)	(0.004)	(0.006)	(0.006)
Median age$_{c,t-1}$	0.004	0.002	0.004	0.005	0.002
	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)
High school graduate (%)$_{c,t-1}$	0.002	−0.005	0.002	−0.005	−0.005
	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)
N	1,008,508	797,608	1,008,508	797,608	797,608
Adjusted R^2	0.79	0.78	0.79	0.78	0.78
County FEs	✓	✓	✓	✓	✓
Year–Month FEs	✓	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓

Table IA7
Bond sample splits

This table shows the robustness of the results in Table 2 to different bond characteristics. Standard errors are adjusted for clustering by state and year-month. ∗, ∗∗, and ∗ ∗ ∗ indicate statistical significance at 10%, 5%, and 1%.

	Main explanatory variable								
	Has funds			Ln(TNA)			Ln(# funds)		
	N	β	R^2	N	β	R^2	N	β	R^2
(1) Baseline	1,008,508	0.066*** (0.012)	0.685	797,608	0.018*** (0.005)	0.678	797,608	−0.066*** (0.012)	0.679
(2) AAA/AA rated	770,806	0.067*** (0.011)	0.660	608,954	0.010* (0.005)	0.651	608,954	−0.062*** (0.011)	0.652
(3) A rated and below	237,684	0.102*** (0.021)	0.721	188,638	0.061*** (0.013)	0.716	188,638	−0.032 (0.021)	0.716
(4) Large issues	503,043	0.037*** (0.012)	0.729	384,868	0.024*** (0.006)	0.726	384,868	−0.081*** (0.015)	0.726
(5) Small issues	505,342	0.102*** (0.015)	0.652	412,643	0.013** (0.006)	0.645	412,643	−0.060*** (0.013)	0.645
(6) Long-maturity bonds	504,016	0.048*** (0.012)	0.685	397,489	0.023*** (0.007)	0.683	397,489	−0.083*** (0.015)	0.684
(7) Short-maturity bonds	504,469	0.067*** (0.012)	0.700	400,101	0.016*** (0.005)	0.699	400,101	−0.049*** (0.010)	0.700
(8) Callable bonds	482,192	0.050*** (0.012)	0.699	382,999	0.026*** (0.007)	0.698	382,999	−0.062*** (0.014)	0.698
(9) Noncallable bonds	526,297	0.051*** (0.012)	0.683	414,594	0.009* (0.005)	0.677	414,594	−0.075*** (0.012)	0.678
(10) General obligation bonds	575,427	0.064*** (0.018)	0.657	483,217	0.027*** (0.007)	0.653	483,217	−0.100*** (0.013)	0.654
(11) Revenue bonds	433,057	0.031** (0.013)	0.720	314,371	−0.001 (0.006)	0.717	314,371	−0.066*** (0.013)	0.718
(12) Bank-qualified bonds	396,022	0.125*** (0.015)	0.653	332,543	0.017*** (0.007)	0.648	332,543	−0.017 (0.012)	0.648
(13) Non-bank-qualified bonds	612,468	0.032*** (0.012)	0.741	465,055	0.006 (0.006)	0.738	465,055	−0.120*** (0.015)	0.739

Table IA8
Yield spreads and local mutual funds: Heckman correction

This table reports results of Table 2, corrected for the propensity that some local governments do not issue bonds. Panel A reports the results of probit regression of the indicator that a county has any bond issues in a given year on its characteristics:

$$I(Has\ issues)_{c,t} = \Phi(\beta' X_{c,t-1} + \varepsilon_{c,t}),$$

where c indexes counties and t years. Standard errors are adjusted for clustering by year. Panel B reports Table 2's results, corrected using Heckman two-stage sample selection model. λ indicates inverse Mills ratio from the first-stage regression. Other variable definitions are in Appendix Table B1. Standard errors are adjusted for clustering by state and year-month. $*$, $**$, and $***$ indicate statistical significance at 10%, 5%, and 1%.

Panel A: First-stage probit

	Raw estimates (1)	Marginal effects (2)
$\text{Ln(GDP)}_{c,t-1}$	0.500***	0.148***
	(0.042)	(0.013)
$\text{Ln(Population)}_{c,t-1}$	0.170***	0.050***
	(0.048)	(0.014)
$\text{Ln(Average wage)}_{c,t-1}$	−1.152***	−0.340***
	(0.137)	(0.042)
$\text{Ln(House value)}_{c,t-1}$	−0.586***	−0.173***
	(0.041)	(0.011)
$\text{Unemployment rate (\%)}_{c,t-1}$	−0.013	−0.004
	(0.010)	(0.003)
$\text{Median age}_{c,t-1}$	−0.021***	−0.006***
	(0.002)	(0.001)
$\text{High school graduate (\%)}_{c,t-1}$	0.048***	0.014***
	(0.001)	(0.000)
Constant	4.629***	
	(0.324)	
N	33,944	33,944
Pseudo R^2	0.24	

Table IA8—*continued*

Panel B: Second-stage results

	(1)	(2)	(3)	(4)	(5)
Has funds$_{s,t-1}$	0.067***				
	(0.012)				
Ln(TNA)$_{s,t-1}$		0.019***		0.047***	0.034***
		(0.005)		(0.010)	(0.008)
TNA per capita$_{c,t-1}$			0.084***		
			(0.025)		
Ln(# funds)$_{s,t-1}$				−0.066***	
				(0.012)	
Ln(HHI TNA)$_{s,t-1}$					0.061***
					(0.015)
Ln(Maturity)$_b$	0.232***	0.234***	0.232***	0.233***	0.233***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Ln(Offering amount)$_b$	−0.009***	−0.010***	−0.009***	−0.010***	−0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Callable$_b$	0.229***	0.223***	0.229***	0.224***	0.224***
	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)
General obligation bond$_b$	−0.088***	−0.079***	−0.088***	−0.079***	−0.079***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Bank qualified$_b$	−0.151***	−0.154***	−0.151***	−0.154***	−0.154***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Ln(GDP)$_{c,t-1}$	−0.264***	−0.273***	−0.262***	−0.258***	−0.275***
	(0.033)	(0.042)	(0.033)	(0.042)	(0.042)
Ln(Population)$_{c,t-1}$	−0.257***	−0.262***	−0.205***	−0.247**	−0.220**
	(0.075)	(0.099)	(0.078)	(0.098)	(0.095)
Ln(Average wage)$_{c,t-1}$	0.490***	0.438***	0.487***	0.397***	0.426***
	(0.086)	(0.103)	(0.086)	(0.103)	(0.103)
Ln(House value)$_{c,t-1}$	0.354***	0.295***	0.330***	0.304***	0.291***
	(0.051)	(0.070)	(0.052)	(0.069)	(0.068)
Unemployment rate (%)$_{c,t-1}$	0.036***	0.041***	0.037***	0.042***	0.042***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Median age$_{c,t-1}$	0.004	0.002	0.004	0.004	0.003
	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)
High school graduate (%)$_{c,t-1}$	−0.011***	−0.015***	−0.011***	−0.014***	−0.015***
	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)
$\lambda_{c,t}$	−0.616***	−0.554***	−0.607***	−0.521***	−0.559***
	(0.099)	(0.130)	(0.100)	(0.131)	(0.130)
N	1,008,508	797,608	1,008,508	797,608	797,608
Adjusted R^2	0.68	0.68	0.68	0.68	0.68
County FEs	✓	✓	✓	✓	✓
Year–Month FEs	✓	✓	✓	✓	✓
Rating FEs	✓	✓	✓	✓	✓