TAX EXEMPTION OF STATE AND LOCAL DEBT: WHO BENEFITS?

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Abstract

The longstanding "muni puzzle" is a controversial empirical finding that the tax exemption of interest income on debt issued by state and local governments benefits investors more than the issuers. In this study, I provide a new approach to measuring interest savings associated with issuing tax-exempt municipal bonds (munis) and present empirical evidence dismantling the puzzle. I show that the tax policy is effective and consistent with theory, after accounting for idiosyncratic issuer risk and investor preference. I match tax-exempt munis to near-identical taxable munis issued by the same government at the same time with the same security characteristics to identify the slope of and the trend in implied marginal tax rates. Results of the random coefficients model, which mitigates issuer- and issuance-level unobserved effects, predict the slope of the marginal tax rate to be consistent with asset pricing theory and the tax profile of the typical muni investor. Findings imply heterogeneity in implied marginal tax rates across issuers due to variations in idiosyncratic risks as well as cyclicality over time.

Keywords: federal tax expenditure, municipal bonds, muni puzzle, tax exemption policy, implied tax rate.

JEL codes: G12, H71, H74.

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1 INTRODUCTION

Most municipal securities (munis) are exempt from federal, state, and certain local income taxes.[1] Such triple tax exemption allows subnational[2] governments to borrow at a lower cost compared to corporations and other institutional borrowers. At the same time, tax-exempt munis are attractive to various market participants, especially investors in high marginal tax brackets who wish to reduce their tax burden. Given that the federal and state governments forgo large sums of tax revenue due to the exemption policy, a common concern is that issuers do not recoup the full benefits of the exemption. One of the main concerns policy makers often express is that benefits of this tax expenditure mostly accrue to high-net-worth investors rather than sufficiently reducing borrowing costs for debt-issuing state and local governments.

Academic researchers have identified an inconsistency between what the theory predicts about the interest costs on tax-exempt securities (in comparison to other taxable fixed-income asset classes) and what is observed in the muni market. The traditional asset pricing theory suggests that, in equilibrium, the difference in interest rates on taxable and tax-exempt bonds that are otherwise identical should be associated with the marginal investor's marginal tax rate. This longstanding finding that the interest rates on *longer-term* tax-exempt municipal securities seem too high (implied marginal tax rates are too low) is commonly referred to as the "muni puzzle." Existing literature, outlined in Section 2, suggests that the implied marginal tax rate associated with long-term tax-exempt securities is about 20–25 percent. However, given the current corporate and individual income tax rates of the typical muni investors, theory predicts an implied marginal tax rate of about 35 percent for a typical longer-term muni. The 10-15 percentage point difference between the theoretical and extant empirical estimates of the implied marginal tax rates would suggest that tax-exempt issuers may be significantly overpaying in interest costs. In this study, I show that the empirical estimates of the implied marginal tax rates align with the theoretical estimate after accounting for idiosyncratic issuer risk and market demand. Thus, financial markets are fully pricing in the tax exemption and issuers are borrowing at interest rates consistent with theory.

Three key points set the stage for this study. First, the municipal securities market, with $3.8 trillion in outstanding debt, is a significant portion of the U.S. capital markets. Second, tax exemption of municipal securities is often on the chopping block by Congress due to the mere size of the corresponding tax expenditure. The muni puzzle suggests that the federal and state governments waste tax dollars by subsidizing subnational borrowers' interest costs and that the benefits of the policy may be mostly accruing to investors. Thus, understanding the effect of the policy on borrowing costs through implied reductions in interest costs (implied marginal tax rates) is crucial. Third, the muni puzzle implies that state and local governments may be overpaying in interest for tax-exempt

[1]The 1988 Supreme Court case *South Carolina v. Baker* ruled that the federal government can tax the interest earned on municipal bonds. Therefore, the exemption of interest income from federal taxation is considered a form of federal subsidy.

[2]All debt issued by state and local (subnational) governments is commonly referred to as municipal debt, tax status of which is determined at issuance.

bonds. Addressing the puzzle, therefore, can settle the debate on whether the subsidy (in the form of tax exemption) significantly lowers borrowing costs for municipal governments and encourages investment in public infrastructure rather than just helping the rich [investors] get richer.

This study tackles the muni puzzle in a novel way by estimating the market-implied marginal tax rates associated with municipal securities with a new level of precision. This estimate, in turn, can identify interest cost reductions accrued to state and local issuers and tax reduction benefits accumulated to investors. In this analysis, I match tax-exempt munis to their near-identical taxable counterparts and construct a sample of pairs of tax-exempt and taxable munis issued by the *same issuer at the same time for the same public project*. Note that state and local governments can and do issue taxable municipal bonds (I discuss this in Section 2). This matching technique accounts for underlying idiosyncratic risks, investor preference for municipal securities over other fixed-income asset classes, and potential preference for specific issuers' debt.[3] I argue that the puzzle driving the previous findings of seemingly and relatively high interest rates on longer-term exempt municipal securities is partially due to the poorly approximated idiosyncratic risks borne by the bond holders.

Except for Atwood (2003), all of the previous studies, described in Section 2, estimate implied marginal tax rates by analyzing the relative yields between tax-exempt municipal securities and either (taxable) corporate bonds, Treasuries, or Build America Bonds. I argue that such a comparison is a poor approach at best and analyze the relative yields of tax-exempt and near-identical taxable municipal securities. First, municipal, corporate, and Treasury bonds have different underlying risk and reward properties. The Build America Bonds, although in the muni market realm, were a temporary and special (experimental) asset class which may not be the appropriate comparison group for all tax-exempt debt. Therefore, this type of apples to oranges comparison utilized in the literature can introduce serious bias. Second, it is important to account for investor preference for munis over other asset classes as well as preference for specific issuers. Investors may prefer munis to Treasuries for reasons other than tax exemption. For example, if the investor has a preference for smaller forms of government for political, idealogical, or other reasons, she may prefer her town's bonds to federal debt. My results imply that the tax-exemption policy is effective at sufficiently reducing borrowing costs for general-purpose governments. The random coefficients model predicts that the implied marginal tax rate is 34 percent for a typical muni, consistent with theory and the tax profile of a typical muni investor.

One concern with employing the matching technique used in this study is whether the final matched sample is representative of the full muni universe. Although this matched final sample may not be perfectly representative of the muni universe, the observed differences between the full and matched sample are reasonably distributed, as explained in Section 4.2. The distribution of issuers and various security types is similar in the matched and full cleaned samples. Despite the fact that the matched sample may not

[3]In Section 2 I discuss why an issuer may choose to issue taxable and near-identical tax-exempt muni pairs simultaneously.

be perfectly representative of the muni universe, it is still the closest we have come to a proper apples to apples comparison in estimating the implied marginal tax rates in the municipal bond market.

Contributions of this study are as follows: First, this study addresses the longstanding "muni puzzle" for general-purpose subnational governments. Estimates of the implied marginal tax rate are consistent with the tax burden of a typical muni investor at around 34 percent for a typical longer-term muni.[4] Results indicate that the tax exemption policy is effective at reducing interest costs by an amount that is consistent with the federal tax expenditure. Second, results show that there is significant heterogeneity in implied marginal tax rates for different types of issuers (levels of government). School and special districts tend to get less interest cost reductions on exempt debt compared to general purpose municipalities such as counties, cities, towns, and townships. This is because implied marginal tax rates are not just a function of the investor's income profile. Implied marginal tax rates are also a function of market supply, market demand, and the issuer's idiosyncratic risk profile. For example, if the market supply is low, investors may settle for lower tax reduction benefits (lower implied marginal tax rate) to balance their portfolios. Similarly, if the county's idiosyncratic risk is lower than a city's idiosyncratic risk, an investor may agree to a higher price/lower implied marginal tax rate for that county's exempt muni bond compared to the city bonds, all else equal. Extant literature has neglected the effect of issuer types and to my knowledge this is the first study to identify the heterogeneity in implied tax rates by issuer types.

Third, I estimate the slope of the implied marginal tax rate over maturity horizons (Figure 5). As expected, the implied marginal rates decrease as the investment horizon increases due to uncertainty in future returns and individual marginal income tax rate changes. However, the slope is less steep than previously argued by the "muni puzzle" supporters, dropping from 37 percent for short-term bonds to only about 31 percent for longest-term bonds. My estimates are consistent with theory and inconsistent with the muni puzzle estimates. Fourth, I show that the implied marginal tax rates are not static and respond cyclically to the economic environment and market demand. Results show that the implied marginal tax rates were highest during the recent financial crisis and have been slowly declining since. Why would the marginal tax rate shoot up during the 2007-2009 crisis when the marginal tax rate of wealthy individuals is likely to go down? One explanation is that the recession and the financial crisis increased market demand for safe and stable assets such as munis. Munis are still considered one of the safest asset classes. Further, increased demand is likely to translate into more favorable borrowing costs (higher interest rate reduction and therefore, higher implied marginal tax rates) for state and local governments.

[4] See Section 5.3 for a discussion of the typical muni investor's tax profile.

2 REVIEW OF THEORY AND LITERATURE

Access to tax-exempt debt financing by state and local governments via a public market[5] is purely an American phenomenon. One of the benefits of this policy is that it encourages investment in essential infrastructure and public projects in the spirit of fiscal federalism. Due to this tax exemption policy, state and local governments pay lower borrowing costs. Investors, in turn, are willing to accept lower returns on exempt securities because interest income is not taxable. Tax-exemption is, therefore, built into the muni interest rates. Traditional asset pricing theory suggests that, in equilibrium, a marginal investor should be indifferent between a taxable and an identical tax-exempt security if the following equation holds:

$$y_{Exempt} = (1-\tau)y_{Taxable} \tag{1}$$

where y_{Exempt} is the yield to maturity[6] for a tax-exempt security, $y_{Taxable}$ is the yield to maturity for a taxable security, and τ is the marginal tax rate for the marginal investor. Therefore, if we observe that an investor is indifferent between a tax-exempt security, $y_{Taxable}$, and a taxable security, $y_{Taxable}$, then this investor's marginal tax rate is theorized to be equal to τ.

A crucial observation for this paper is that state and local governments have the option to issue taxable municipal bonds. Forgoing the tax-exempt status gives the issuers access to investors who have little or nothing to gain from the exemption status.[7] Access to these investors is valuable to issuers if there is lack of demand in the tax-exempt market. Further, forgoing tax-exempt status frees governments from the administrative burden of abiding by numerous SEC and IRS rules and regulations associated with issuing exempt securities. Smaller issuers with less administrative resources may especially value this freedom in terms of private use and reporting.[8] The IRS regularly audits tax-exempt municipal bonds to assure compliance with the Code. Of these 400 or so audits per year, about 25 percent result in non-compliance and "taxability."[9] Further, if the issuer is not completely certain about the use of proceeds in a project with many components, some of which may not be of public value, that issuer may choose to issue a portion of the bonds

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[5]There are other forms of debt-financing around the world where investors earn tax-free interest. Government-sponsored bank loans are one example.

[6]Given price P, coupon rate (and therefore, coupon payments), and maturity amount (face value), the yield to maturity, y, is determined based on the following formula:

$$Price = \sum_{t=1}^{T} \frac{\text{Coupon Payments}_t}{(1+y)^t} + \frac{\text{Face Value}}{(1+y)^T} \tag{2}$$

where $T-t$ is the time remaining until maturity and T is the maturity date. The offering price is set by the underwriters.

[7]These include, but are not limited to, foreign investors, pension funds, international entities, individual IRAs, etc.

[8]See the Post-issuance Compliance section of the IRS Publication 4079 at https://www.irs.gov/pub/irs-pdf/p4079.pdf.

[9]See the Treasury report at https://www.treasury.gov/tigta/auditreports/2012reports/201210087fr.pdf.

as taxable. Given more stringent regulations, incentives to issue taxable bonds have increased in recent years, which allows me to identify a large enough matched sample. The important point is that the issuer's decision to issue taxable bonds is a response to market conditions and net necessarily an explicit choice.

It may seem surprising that investors choose taxable municipal bonds over tax-exempt securities. However, the muni market is as diverse on the demand side as it is on the supply side. Some investors in the market gain little to no benefit from tax exemption of interest income. Institutional investors, such as pension funds, international entities, individual IRA accounts, and/or individual foreign investors utilize taxable munis as means to diversify their portfolios or as an alternate asset class to Treasuries, U.S. agency bonds (Freddie, Fannie), corporate bonds, etc. Furthermore, taxable munis should, at least theoretically, offer higher interest than tax-exempt munis.[10] When tax exemption has no value to the investor, she will choose the security with higher return, all else equal. Thus, an issuer may choose to issue a pair of near-identical taxable and tax-exempt securities to access both types of investors, in addition to efforts to reduce audit risks, especially if demand is low.

Another interesting feature of the muni market is that municipal securities are more likely to have a "local flavor." First, investors may have a preference for the state they live in and especially if they only benefit from state income tax-exemption if they reside in the issuer's state.[11] Therefore, investors have an incentive to buy and hold tax-exempt munis issued in their state to recoup the full benefits of the triple tax exemption (federal, state, and local,[12] where applicable).[13] Second, individuals may have a preference for municipal securities over corporate bonds or Treasuries. They may feel more loyal to the locality they live in or be more confident in that locality's credit quality. Moreover, if the investor has a preference for smaller forms of government, she may prefer her town's bonds to state-issued bonds for example. Thus, if investors have a preference for specific issuers (levels of government) within the muni world, then accounting for this variation in implied marginal tax rates by issuer type is crucial in identifying the slope of the implied marginal tax rates.

Several studies attempt to estimate the total monetary costs of the municipal tax exemption policy accrued to the federal government. Poterba and Verdugo (2011) estimate

[10] Another appealing feature for some taxable munis is the stronger protection from early redemptions compared to tax-exempt bonds through the make-whole call feature. The make-whole-call feature of a security generally eliminates the interest costs savings of refinancing. Instead of being callable at par, for securities with this feature, investors are compensated at a price which equals the present value of future interest payments. This is punitive for the issuer, who would otherwise benefit from early redemption. Taxable munis with the make-whole feature are not common and are excluded from the final sample in this study.

[11] For studies on the effects of muni market segmentation, see Pirinsky and Want (2011) and Denison et al. (2009).

[12] It is not possible to identify the local income taxes without a zip-code level investor portfolio data. However, local income taxes rarely apply to municipal bond interest income (except e.g. New York City, where it matters).

[13] In equilibrium, investors have a preference for local bonds but they will also likely invest in out-of-state bonds for diversification purposes (Pirinsky and Want (2011)).

that the federal government forgoes approximately $14 billion in revenue annually due to the tax exemption policy. But Marlowe (2015) estimates that in the absence of the tax exemption program, state and local governments would have paid an additional $714 billion in interest expense between 2000 and 2014 (or $48 billion per year).[14] Given the muni puzzle literature, the opponents of the tax exemption policy argue for a direct federal subsidy to the issuers. The Build America Bond (BAB) program, part of the American Recovery and Reinvestment Act (ARRA) of 2009, presented an interesting experiment in an effort to understand the trade-off between revenue loss and interest cost reductions associated with the muni tax exemption policy. The BAB program subsidized state and local governments for issuing taxable rather than tax-exempt municipal bonds. Issuers received a subsidy in the amount of 35 percent of interest payments on their taxable bonds issued within a 20-month period, although the subsidy was for the life of the bond.

Liu and Denison (2014) match BABs and general taxable bonds to tax-exempt municipal bonds issued in California and find that the implied marginal tax rate for the marginal investor is 25%. Similarly, Luby (2012) estimates an implied tax rate of 24% using two BAB transactions issued by the State of Ohio in 2010. However, California and/or Ohio may not be representative of the entire muni market, and BABs may be perceived as a special asset class by investors, especially given the uncertainty surrounding the program in the initial phases and its limited timespan. I exclude BABs from my sample and analyze issues spanning a 16-year period rather than the 20-month period when BABs were in effect. My data captures issuers across the country of different types (states, cities, counties, districts, etc.) rather than a single state issuer. Finally, Section 4.3 describes why Ordinary Least Squares (OLS) and fixed effects panel regressions may pose econometric issues when unobserved and time-varying issuer- and issuance-level effects are suspect. Further, inputting the implied tax rates into the model rather extrapolating the rates out of the model as coefficients results in loss of granularity, as explained in the Appendix in Section A.1.1.

The muni puzzle debate that interest rates on tax-exempt municipal bonds seem too high has been ongoing for decades. To reconcile the higher than predicted yields on exempt securities with financial theories, studies explore default risk (Chalmers (1998)), call options (Chalmers (1998)), low liquidity and tax-timing options (Ang et al. (2010); Green (1993)), and systematic risk (Chalmers (2006)), among others as possible culprits. Longstaff (2011) compares 1-week tax-exempt muni swap index, muni swaps as well as Treasury, repo, and swap market rates and finds an implied marginal tax rate of 38 percent, a theoretically appropriate average. However, this approach ignores longer-term maturities. The puzzle seems to persist in each of these studies that utilize comparisons to corporate bonds, Treasuries, and/or BABs. An exception is Wang et al. (2008), who find marginal tax rates of about $32-33$ percent, after examining the effect of liquidity, default, and personal taxes on the relative yields of Treasuries and municipal bonds. Only Wang et al. (2008) results reject the muni puzzle. However, they construct portfolios using the

[14] Marlowe (2015) also shows that state and local governments invested approximately $400 billion in various capital projects in 2014, and that nearly 90 percent of subnational government *capital* spending is debt-financed.

secondary market data rather than primary muni market data.

I argue that the primary rather than the secondary municipal bond market is the appropriate setting for muni puzzle analysis for several reasons: First, from state and local debt management perspective, we care about the interest cost reductions (proxied by implied marginal tax rate) for state and local governments due to the tax exemption policy. The debt service that a government will pay for the life of the bond is determined at the issuance. Second, the research design of this paper cannot be identified in the secondary market, as taxable and tax-exempt muni pairs almost never trade simultaneously. Third, the secondary market for municipal bonds is much more complex given the tax treatment of gains and losses. For example, Landoni (2018) outlines these tax distortions associated with Original Issue Premium bonds.

I am aware of only one other study that employs an empirical approach within the confines of the muni world, by linking tax-exempt munis to taxable munis. Atwood (2003) compares a small sample of taxable municipal securities (less than 50) to tax-exempt munis issued on two separate days (July 20, 2001 and May 1, 2002), matching only based on maturity, and finds an implied tax rate of 34–35 percent. This approach has the usual small and non-representative sample concerns (a few issuers, two days). Additionally, because taxables are matched to tax-exempt securities only based on maturity lengths, issuer- and issuance-level effects (observed and unobserved) are ignored. Further, the taxable sample has different features (credit ratings, call option, etc.) than the tax-exempt muni sample and simply adding identifiers for specific features does not eliminate bias concerns. Finally, taxable munis are not a perfect benchmark for tax-exempt munis unless they have the same public benefit features and same backing (general obligation versus revenue).

The investor profile and income tax rates have changed since the Atwood (2003) study. Bergstresser and Cohen (2015), using the Surveys of Consumer Finances, show that municipal debt holdings of households change significantly over time. Despite the increase in the size of municipal debt, ownership has shifted to portfolios of more concentrated investors at the top of the wealth distribution. Further, the highest marginal income tax bracket was revised from 35 percent to 39.6 percent in 2013 and then down to 37 percent in 2017, all of which is captured in my 2001–2017Q2 sample.

It seems that the literature in the last few decades has ignored Trzcinka (1982), who states: "... when risk is properly accounted for, the resulting estimate of the marginal tax rate is very close to ... one minus the corporate tax rate." I find an implied marginal tax rate with a tight confidence interval that includes the corporate income tax rate for my sample and therefore, show that correctly accounting for idiosyncratic risks, conditional on sufficient market demand, addresses the muni puzzle. Further, Trzcinka (1982) notes: "In general, however, the supply of tax-exempts is not purchased entirely by investors paying the corporate tax rate so that, according to the institutional demand theory, the marginal tax rate varies directly with commercial bank participation in the tax-exempt bond market." Given that individuals hold the majority of munis for my time period, I should and do find a marginal tax rate that is between the marginal tax rates of the typical institutional and individual muni investors.

3 DATA

3.1 Data Sources

The data for this study come from the Municipal Securities Laboratory at the Andrew Young School of Policy Studies at Georgia State University. The main data source is Mergent's proprietary Municipal Bond Securities Database (MBSD) on all primary market issuances. This database contains the CUSIP numbers and issuance information, including issuance and maturity dates, debt type, coupon type, capital purpose, use of proceeds, credit rating and other enhancements, call features, original sale type, etc.[15] Mergent database includes a variety of information on more than 3.5 million securities.

I also use a market benchmark data provided by the Municipal Market Analytics (MMA), a proprietary data not available to the public.[16] The MMA Consensus yield curve represents a survey of leading investment firms, both buy and sell-side, of interpreted benchmark AAA GO levels from primary and secondary transactions. The data represents a 5% coupon structure and a 10-year par call. In this study, the MMA Consensus yield provides a proxy for the prevailing rates in the muni market and is available from 2001. Given this benchmark yield curve, I construct a market yield variable by matching each CUSIP to the corresponding part of the MMA curve by exact date and maturity length (one to 30 years).[17]

3.2 Exclusion Criteria

Table 2 shows the exclusion criteria prior to matching.[18] Section 2 explains why BABs are different and therefore excluded. Variable rate securities[19] are complex and their analysis is beyond the scope of this study. Securities with less than one year until maturity are of limited quantity and are excluded as a precaution that preferential tax treatments are unlikely to matter significantly for investors with short investment horizons.[20] I also exclude securities subject to state taxes to avoid the confounding effects between federal and state taxes. The criteria 6–8 in Table 2 do not have a significant effect on the sample size and I exclude these as a precaution that demand may vary differentially for taxable

[15]Unfortunately, there is no information on credit upgrades/ downgrades in the database. It is plausible that recent upgrades/downgrades and/or credit watches may have an effect on offering yields; however, there is no reason to suspect that this effect would affect taxable and tax-exempt munis differently. The relative yields, which determine implied marginal tax rates, should not be affected. Further, the model accounts for such effects through unobserved issuer variations.

[16]I would like to thank Municipal Market Analytics, Inc., especially Tripp Kaiser, for allowing me to use the MMA yield curve in this research.

[17]Note that MMA is available for weekdays only. If the issue date (dated date) of a security falls on a Saturday, that observation is matched to the MMA yield from the day before (Friday). If the dated date falls on a Sunday, that observation is matched to the MMA yield for the next day.

[18]These exclusions results in a 15% reduction in the original sample size.

[19]These are adjustable, deferred, floating auction, floating, floating at floor, inverse floater, index-linked, stripped, stripped convertible, stripped principal, stepped, or variable rate coupons.

[20]Results are robust to inclusion of these securities.

Table 1: Variable Descriptions and Data Sources

Variable Name	**Description and Measurement**	**Source**
	Dependent variable	
Tax-exempt Yield	Yield offered to the initial investor	Mergent
	Independent variables	
Taxable Yield	Yield offered to the initial investor	Mergent
Coupon Difference	Tax-exempt coupon rate - Taxable coupon rate	Mergent
Maturity Size Difference	(Tax-exempt maturity size - Taxable maturity size) / 100,000	Mergent
Issue Size Difference	(Tax-exempt issuance size - Taxable issuance size) / 100,000	Mergent
Issuer Type	Indicators for city, county, state, school district, special district, and town/township	Mergent[a]
Competitive Sale	Indicator for competitive sale (vs. negotiated)	Mergent
Callable	Indicator for call feature	Mergent
Sinking Fund	Indicator for sink fund	Mergent
Rated	Indicator for whether the issue was rated by one of the credit rating agencies	Mergent
General Obligation	Indicator for general obligation vs. revenue debt	Mergent
Insured	Indicator for presence of insurance	Mergent
New	Indicator for new money versus refunding	Mergent
Demeaned Market Spread	Tax-exempt offering yield - yearly average MMA yield by maturity	Mergent, MMA

Notes: [a]*Author's classification based on the issuer's name in Mergent.*

Table 2: Sample Exclusion Criteria

1	BABs and any other debt types that are not bonds (notes, derivatives, etc.)
2	Variable coupon rates
3	Maturity length < 1 year (notes)
4	Securities subject to state tax or with state tax status missing
5	Capital purpose other than new or refunding
6	Interest rate frequency other than semiannual or at maturity
7	Securities with make-whole-call feature
8	Debt issued by U.S. territories and their subsidiary governments

and tax-exempt securities based on these features. The summary statistics for the cleaned full sample are in Table 6 and Table 7 in the Appendix.

After the preliminary exclusions, I match taxable and tax-exempt municipal securities as described in Section 4.1. The final matched sample has five below-investment-grade security pairs, which I also drop, since non-investment grade ("high yield") securities tend to attract a specific investor pool. I identify issuer types manually using the issuer names as the data does not contain such classification.

4 RESEARCH DESIGN

4.1 Matching Taxable Munis to Tax-exempt Munis

Almost all of the existing research exploits the spreads between tax-exempt municipal bonds and either Treasuries or corporate bonds to isolate the implied marginal tax rates associated with issuing tax-exempt munis. This study argues that such comparison is an apples to oranges comparison and introduces serious bias. In general, taxable munis are considered to be less risky than corporate bonds and other taxable securities. Given the differences in idiosyncratic risks, munis have a much lower default rate than corporate bonds. The federal government, on the other hand, has never defaulted on its debt, whereas subnational governments have very small, but nonzero, historical default rates. If investors in fact do perceive munis, corporate bonds, and Treasuries as different asset classes, then identifying the value of tax-exemption using the yield spreads between Treasuries (or corporate bonds) and tax-exempt municipal securities is an invalid approach.

Methodology used in this paper utilizes a near-identical matching of taxable and tax-exempt municipal bonds. Recall that a subset of the municipal bond universe does not have the typical exemption feature. Further, state and local governments periodically issue taxable and tax-exempt munis with near-identical characteristics simultaneously, which presents an ideal identification strategy. Comparisons within the same asset class (the muni world) yield a more accurate estimate than comparisons to corporate bonds, Treasuries, or BABs. The intrinsic difference between munis and other fixed income securities, at least through the tax preference, strengthens the justification for this matching approach. Such matching takes advantage of bonds *issued by the same government at the same time with the same security characteristics* to identify the implied marginal tax rates. This results in a final sample with a variety of debt products issued by a variety issuers throughout the country. In essence, this set-up approximates an experimental design where the taxable munis are the control/comparison group for tax-exempt munis. Another important advantage of this matching strategy is that it guards the estimates against bias due to model misspecification and allows us to directly test the relationship in Equation 1.

Figure 1 provides a visual example of and justification for the matching technique used in this study. The excerpt from the Official Statement (OS) of the State of Georgia's 2015 debt issuance shows the parallel between taxable and tax-exempt maturities. Note that both Series 2015A and Series 2015B are general obligation (GO) bonds with the same issue date (July 9, 2015), interest payment frequency (semiannual), credit rating (*Moody's* –

Figure 1: *Excerpt from The Official Statement of The State of Georgia Debt Issuance (2015)*

$560,525,000
State of Georgia
General Obligation Bonds 2015A Maturity Schedule

Maturing February 1,	Principal Amount	Interest Rate	Price or Yield	CUSIP (a)
2016	$28,740,000	5.000%	0.190%	373384Y59
2017	30,555,000	5.000	0.560	373384Y67
2018	32,085,000	5.000	0.960	373384Y75
2019	33,695,000	5.000	1.250	373384Y83
2020	35,375,000	5.000	1.470	373384Y91
2021	20,405,000	5.000	1.720	373384Z25
2022	21,425,000	5.000	1.930	373384Z33
2023	22,495,000	5.000	2.070	373384Z41
2024	23,615,000	5.000	2.210	373384Z58
2025	24,800,000	5.000	2.340	373384Z66
2026	23,350,000	5.000	2.450*	373384Z74
2027	24,515,000	5.000	2.560*	373384Z82
2028	25,740,000	5.000	2.660*	373384Z90
2029	27,030,000	5.000	2.760*	3733842A3
2030	28,380,000	3.000	3.250	3733842B1
2031	29,230,000	4.000	3.260*	3733842C9
2032	30,400,000	4.000	3.310*	3733842D7
2033	31,615,000	4.000	3.350*	3733842E5
2034	32,880,000	4.000	3.390*	3733842F2
2035	34,195,000	3.500	3.580	3733842G0

*Priced to February 1, 2025 optional redemption date.

$447,830,000
State of Georgia
General Obligation Bonds 2015B (Federally Taxable) Maturity Schedule

Maturing February 1,	Principal Amount	Interest Rate	Price or Yield	CUSIP (a)
2016	$30,050,000	0.300%	0.300%	3733842H8
2017	30,345,000	2.250	0.760	3733842J4
2018	30,805,000	1.250	1.250	3733842K1
2019	31,420,000	1.750	1.750	3733842L9
2020	32,050,000	2.050	2.050	3733842M7
2021	20,880,000	2.420	2.420	3733842N5
2022	21,405,000	2.670	2.670	3733842P0
2023	22,045,000	2.780	2.780	3733842Q8
2024	22,710,000	2.980	2.980	3733842R6
2025	23,390,000	3.130	3.130	3733842S4
2026	15,450,000	3.625	3.320*	3733842T2
2027	15,960,000	3.875	3.570*	3733842U9
2028	16,510,000	4.125	3.770*	3733842V7
2029	17,100,000	4.250	3.900*	3733842W5
2030	17,725,000	4.250	4.000*	3733842X3
2035	99,985,000#	4.150	4.150	3733842Y1

* Priced to February 1, 2025 optional redemption date.
\# Term bonds subject to mandatory redemption as described herein. See "DESCRIPTION OF BONDS – *Mandatory Redemption of 2015B Bonds*" herein.

Table 3: Matching Criteria for Tax-exempt and Taxable Muni Pairs

1	issuer	(name)
2	issue date	(day, month, year)
3	maturity date	(day, month, year)
4	coupon type	(par, discount, premium)
5	security type	(general obligation, revenue)
6	capital purpose	(new, refunding)
7	bank qualification	(bank-qualified, not bank-qualified)
8	call option	(callable, not callable)
9	sinking fund type	(sinking fund, no sinking fund)
10	insurance	(insured, uninsured)
11	use of proceeds	(see Table **??**)
12	credit rating	(0-21 scale, average of all ratings)
13	sale type	(competitive, negotiated)
14	state tax status	(exempt only)
15	interest frequency	(semiannual only)

Aaa, S&P – AAA, Fitch Ratings – AAA), and maturity dates. As an example, consider the tax-exempt CUSIP[21] number *373384Y67* maturing on February 1, 2017 with the taxable CUSIP number *3733842J4* also maturing on February 1, 2017. The tax-exempt security has a principal amount of $\$30,555,000$, a 5% coupon rate, and 0.56% offering yield. The taxable counterpart of this security has a principal amount of $\$30,345,000$, a 2.25% coupon, and 0.76% offering yield. Notice that both of these securities are premium coupons (yield is lower than the coupon rate) and neither is callable. These securities are therefore, identical in every way except for coupon rate, yield/price, amount, and of course the tax status. Using Equation 1, the offering yields on the matched pair maturing in 2017 imply a 26.32 percent[22] marginal tax rate. This is a naive estimate because it does not control for unmatched characteristics (e.g. coupon and size differences and other unobserved characteristics such as market demand and issuance-level characteristics).

As the previous example suggests, in order to eliminate underlying idiosyncratic risks and demand differences across different types of securities, taxable and tax-exempt munis are matched based on the criteria in Table 3. Matching on the issuer name eliminates the need to match on issuer specific characteristics, such as state, region, issuer size, etc. Matching by issuer is important because it controls for the effects of unobserved investor preferences for specific issuers. For example, investors may prefer California (CA) bonds over New York (NY) bonds or city-issued bonds over state-issued bonds. Matching criteria 14-15 in Table 3 are null since there is only one category for each of these criteria in the final sample due to the exclusion criteria discussed in Section 3.

Note that matching utilized in this study is exact and one-to-one. If a taxable security

[21] CUSIPs are unique security identifiers issued by the Committees on Uniform Securities Identification Procedures (CUSIP) Bureau.

[22] $\tau = [1 - \frac{0.56}{0.76}] = 0.2632$ or 26.32%.

is matched to multiple exempt securities, then I keep the match with the smallest maturity amount difference. If the exempt security is matched to multiple taxable securities, again only the match with the smallest maturity amount difference is kept. Eliminating duplicate matches for taxable securities eliminates biased sample concerns.[23] The matching technique described above would result in five matches for the issuance displayed in Figure 1 - securities maturing in 2017 and 2026-2029, highlighted in yellow. The rest of the maturities would drop out either because of differing coupon types or call features. For example, the 2019 exempt maturity is a premium coupon (coupon rate is greater than the offering yield) whereas the 2019 taxable maturity is a par coupon (coupon rate is equal to the offering yield).

In addition to coupon types (par, discount, premium[24]), coupon rates matter as well. Anecdotal evidence suggests that investors have an unusual preference for five percent coupon munis. Unfortunately, matching on coupon rates is not feasible, as taxable and tax-exempt bonds tend to have different coupon rates. This level of restriction on matching would result in an extremely small sample. Similarly, maturity and issue sizes are not used as matching criteria. Therefore, these differences are added as controls in the final model.

4.2 Final Sample and Generalizability

The final matched sample includes 6,463 matched pairs of taxable and tax-exempt securities. The unit of analysis is a CUSIP, which is the security-level identifier. Unit of observation is CUSIP-day. The time frame overlap among the data sets captures the 2001 through 2017Q2 period. In addition to data availability and overlap between datasets, this 16-year period provides a sufficient time lapse before and after the Great Recession formally defined as the period between 2007Q4 an 2009Q2. Variable descriptions, data sources, and covariate constructions are described in Table 1. Table 5 in the Appendix provides the summary statistics for the final matched sample.

One concern with employing the matching technique used in this study is whether the final matched sample is representative of the full muni universe. First, it it important to note that state and local governments are engaged in numerous optimization decisions. These governments first choose a public project to be implemented, then decide whether or not to finance it via public markets, and finally, whether to issue exempt debt or a combination of exempt and taxable debt. A potential concern is that the choice of taxable or tax exempt debt may be endogenous. However, anecdotal evidence suggests that the latter is not necessarily a decision, but rather a response to market conditions. For example, if demand for exempt debt is low and the IRS audit risk is high, an issuance is more likely to be a combination of near-identical taxable and tax-exempt debt to achieve market clearance. Therefore, there is no known reason to expect that governments that

[23] An alternate solution is to weigh the sample, but identifying the sample weights can be rather arbitrary.

[24] Original Issue Premium bonds are the most common coupon type found in the muni market. See Landoni (2017) for a discussion.

issue tax-exempt debt are different from governments that issue both taxable and tax-exempt debt.

Although this matched final sample may not be perfectly representative of the muni universe, the observed difference between the full and matched sample is not drastic. First, Table 8 shows that school and special districts together comprise the majority of the securities in the matched and unmatched samples. Cities are the next most frequent issuers and finally, the smaller municipalities, such as towns and townships, are the least frequent issuers in the matched and unmatched samples. The matched sample summary statistics in Table 5 are replicated for the full sample in Table 6 and Table 7. Despite the fact that the matched sample may not be perfectly representative of the muni universe, it is still the closest we have come to a proper apples to apples comparison in estimating the implied marginal tax rates in the municipal bond market.

4.3 Model

I estimate the tax rate at which the marginal investor would be indifferent between taxable and tax-exempt municipal bonds for each maturity length for each year using the random coefficients model (RCM). The RCM has several advantages over traditional empirical models. First, it accounts for dependency across observations. Given that securities are clustered within issuances and issuances are clustered within issuers, there are multiple sources of correlation. Second, different issuers may have different idiosyncratic risks not captured fully by their credit ratings. Further, these issuer-level effects may change over time. The RCM can account for such issuer and issuance heterogeneity. Finally, the RCM does not require that the panel data be balanced. The primary muni market data is not balanced by design – some subnational governments issue new debt every year whereas other issuers go to the market less frequently.

The RCM is a more appropriate empirical strategy to identify, model, and leverage unobserved, but important, heterogeneity in the municipal bond market. Random coefficients/ slopes on the key variable of interest allow the effect of this covariate to vary at multiple levels (by issuer and by issuance). The levels/dimensions in this study are defined as securities within issuances within issuers. The RCM with issuer- and issuance-level random effects study can be expressed as:

$$y^E_{ijkt} = (\beta_1 + \theta_j + \lambda_k) y^T_{ijkt} + \beta_2 X_{ijkt} + \beta_3 Z_{ijkt} + \epsilon_{ijkt} \quad (3)$$

where y^E is the tax-exempt offering yield[25] for i^{th} security within j^{th} issuance for k^{th} issuer at time t and y^T is the offering yield for the taxable counterpart. The key variable of interest is the taxable yield, y^T, and the corresponding fixed and random coefficients at the issuer and issuance levels. The model does not include any intercept (fixed or random) in order to uniquely capture the relationship described in Equation 1. β_1 captures the fixed effect of the key variable. This is the mean effects of the covariate in the population. The θ captures the unobserved effects at the issuance level and λ captures the unobserved

[25] Offering yield is equal to yield to maturity at the time of issuance. Offering yield is equal to yield to call for callable securities.

effects at the issuer level. Conditional on the covariates, these issuance- and issuer-level random effects are equal to zero in expectation. Consequently, I analyze the variance of the random effects by evaluating their point estimates and standard errors. Finally, Z is the vector of covariates used in matching[26] and X is the vector of additional controls.

5 FINDINGS

5.1 Descriptive Results

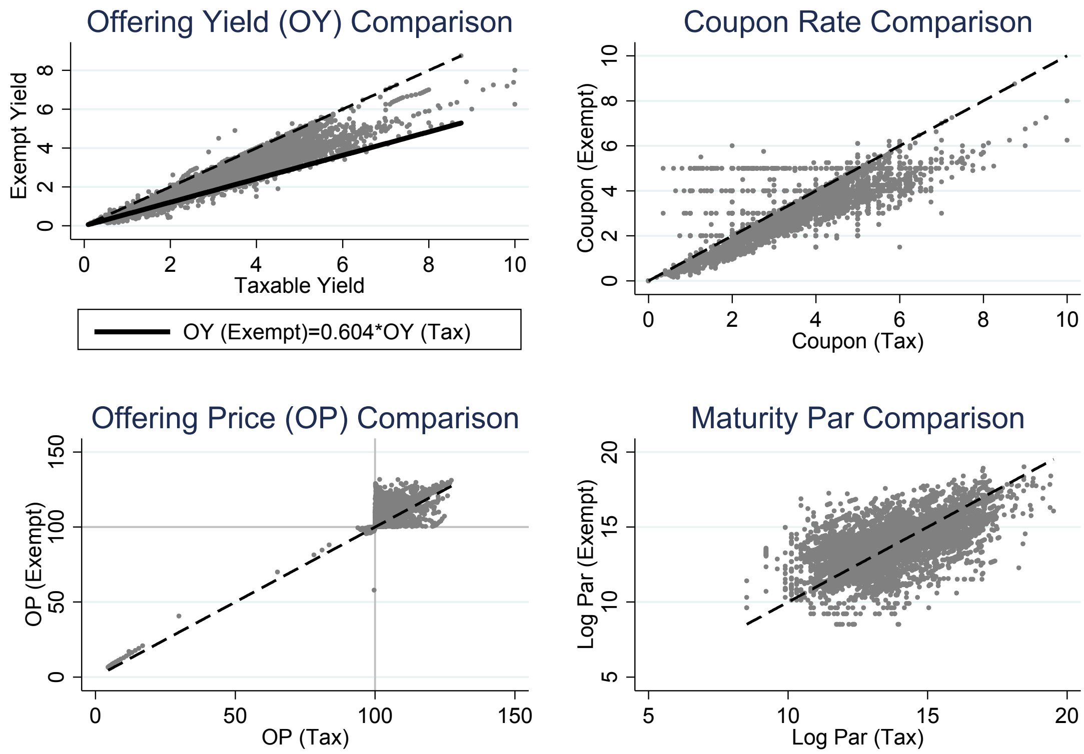
Figure 2 and Figure 3 provide visual demonstrations of the matching results. The first panel of the Figure 2 shows the relative yields in the matched sample. Observations on the 45°line (dashed) would indicate that the taxable yields are equal to tax-exempt yields, implying a zero implied marginal tax rate. With a few exceptions, as expected, the offering yields for taxable securities are higher than that of the matched exempt yield and lie below the 45°line, as expected. The observations above the 45°line imply a tax burden rather than a tax benefit associated with these maturity pairs. There is no theoretical reason why this should be the case, unless there are coupon and size differences. Further, lack of market demand (under-subscription) for specific securities may shrink the spread between taxable and tax-exempt securities. For example, if there is a lack of demand for tax-exempt securities, issuers will have to offer higher interest (reducing the implied marginal tax rates and therefore, the interest reduction benefits) to sell all bonds/clear the market.

The solid line in the first panel of Figure 1 captures the theoretical indifference line for the marginal investor in the highest income tax bracket of 39.6 percent.[27] Recall that, due to the exclusion criteria, none of these securities are subject to state taxation. This indifference line corresponds to Equation 1 where $(1 - \tau) = 1 - 0.396 = 0.604$. If there were no other differences other than tax status (e.g. coupon differential, face value, issuer- and issuance-level unobserved effects, etc.), theory predicts that all observations would lie on this solid line for the marginal individual investor. If the average muni investor has a tax rate which is lower than the highest tax rate, then the observations would need to be somewhere between the solid and the dashed lines for these securities to clear the market. Notice that there are a significant number of observations below the solid indifference line implying marginal tax rates above the highest tax bracket. This warrants a more rigorous analysis to see if these relationships remain after adjusting for coupon/size differentials and unobserved effects. The last two panels of Figure 2 show

[26]Variables used in matching, Z, are included as covariates for several reasons. Matching on these covariates only eliminates the main effects of Z. If there are indirect effects on yield between Z and the tax/no tax treatment, then there will likely still be a significant effect in the model. Further, note that I am not matching on the tax status (taxable versus tax-exempt). Rather, I am matching on tax-exempt and taxable yields which have significant between variation and matching only takes care of the within variation.

[27]The highest income tax bracket was ultimately reduced to 37 percent with the 2017 tax reform. However, I keep 39.6 percent rate as the benchmark since I only have two quarters of 2017 data.

Figure 2: *Visual Representation of Matched Pairs*



the relative price and size comparisons of the matched pairs.[28]

Table 5 in the Appendix provides the summary statistics for the final sample and shows that the average coupon rate is 31 basis points higher for taxable securities than for exempt securities. However, the coupon comparison panel of Figure 2 shows that this relationship is not consistent and for a portion of observations - taxable securities offer lower coupons than their tax-exempt twins. Of the 6,463 CUSIP pairs, 27 percent have call options attached to them, 23% are insured, 48 percent are rated, 44 percent are new issues, 25 percent are general obligation bonds, and only 4 percent have a sinking fund feature. The average maturity horizon of a matched pair is about eight years.

Figure 3 demonstrates the distribution of the naive implied tax rate, which I calculate by comparing the offering yields of the matched pairs using Equation 1. The implied tax rate ranges from values above the theoretical range (35–39.6 percent) extending into negative values, which imply a tax burden rather than a tax reduction benefit. Such heterogeneity in the naive rates warrants a more rigorous approach and supports the claim that a single point estimate for the implied marginal tax rate without accounting for issuer- and issuance-level variation may be driving the muni puzzle.

Figure 4 shows the variation in the naive implied tax rate by issuer type/level of government (cities, counties, states, school districts, special districts, and towns/townships).

[28]The extreme outliers (price < 50) in the offering price panel of Figure 2 are securities issued by a single school district in Texas. Results are robust to exclusion of these observations.

Figure 3: *Distribution of the Naive Implied Marginal Tax Rate, τ*

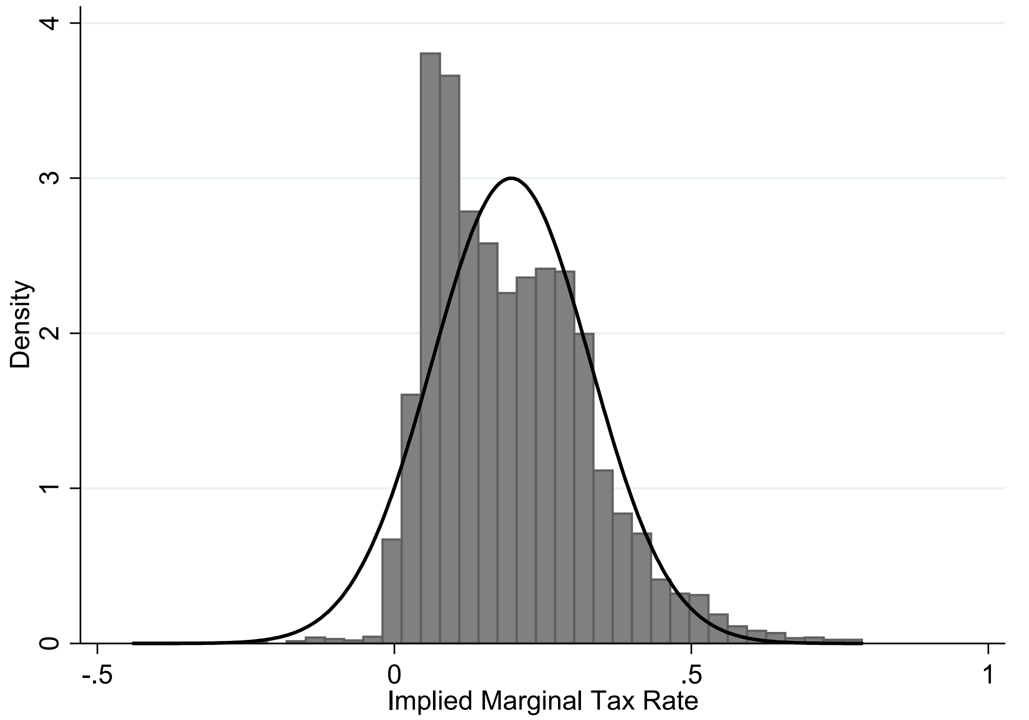
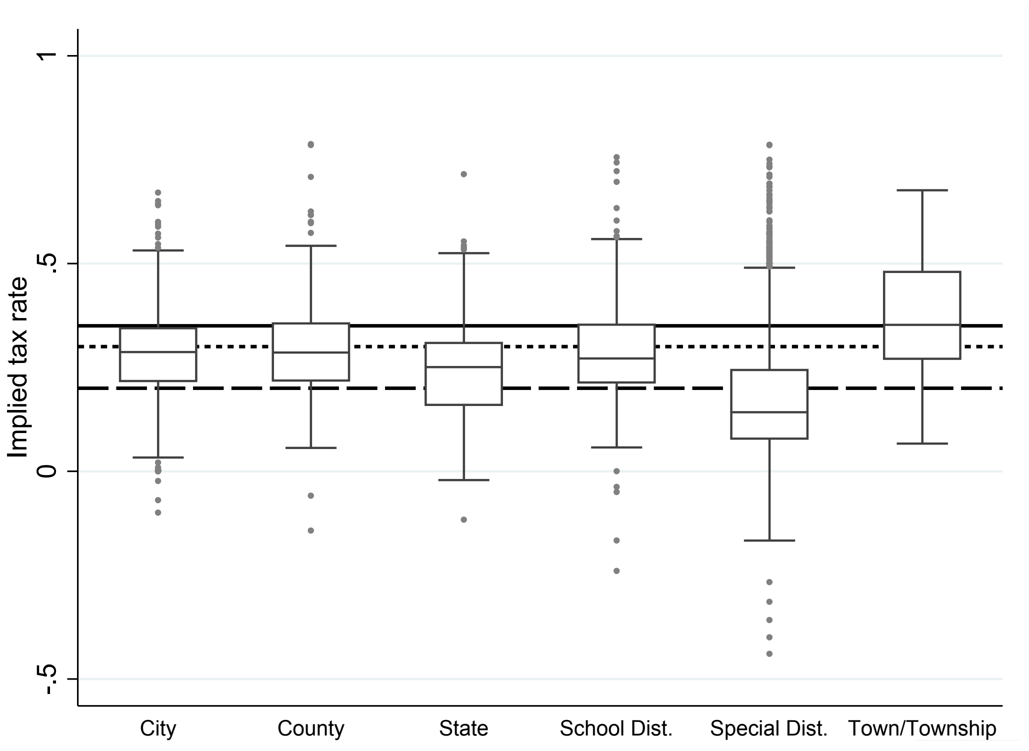


Figure 4: *Distribution of Implied Marginal Tax Rate, τ, Post-match, by Issuer Type*



Notes: Solid = 35%, *Short-dash* = 30%, *Long-dash* = 20%

Again, the naive implied tax rate here is simply the binary relationship between matched taxable and exempt offering yields based on Equation 1. The horizontal lines mark the 35% (solid), 30% (short-dash), and 20% (long-dash) tax rates, which are the highest corporate income tax rate, lower bound of the effective individual income tax rate for a typical muni investor, and typical estimate of the implied tax rate found in the literature, respectively. Figure 4 shows that there is quite a bit of variation in implied tax savings offered by various types of governments.[29] According to the box plot, the median naïve implied tax rate is around 35 percent for small municipalities such as towns and townships and around 30 percent for cities, counties, and school districts. However, implied tax rates are near 18 percent for special districts, and at about 25 percent for states. This suggests that different levels of government may be getting different levels of interest cost reduction benefits from the tax-exemption policy. However, Figure 4 does not include any controls and cannot account for fluctuations in the implied marginal tax rates over time.

5.2 Empirical Results

Table 4 presents the RCM estimates using Equation 3. Model (1) shows the RCM results without controlling for unobserved issuer and issuance-level results; Models (2) shows the RCM results with issuer- and issuance-level variation and Model (3) only uses the general-purpose government subsample of the final matched sample by dropping school and special districts. The reference group is a new, non-callable, uninsured, unrated, 10-year,[30] revenue bond security-pair issued by a city in 2014 where the matched pair have no coupon, maturity, or issue size differences (covariates are set to zero). Results in Model (3) show that a one percentage point increase in the taxable offering yield results in a 65.8 basis points increase in the tax-exempt yield. This estimate implies a marginal tax rate of 34.2 percent, an estimate consistent with theory and the tax profile of a typical muni investor.

A confidence interval of $[0.65, 0.66]$ on the key independent variable, the taxable yield, in Model (3) in Table 4 indicates an implied marginal tax rate of 33 to 34 percent with an additional basis point deviation by issuer and another basis point deviation by issuance.[31] Recall that positive coefficients shrink the spread between taxable and tax-exempt yields, decreasing the implied tax rates. Further, the results show that special districts pay higher interest costs than the rest of the issuers on their exempt debt, while cities, towns, and townships recoup close to full benefits of the exemption policy. This is consistent with the argument that investors may prefer one issuer over another, especially if there is large variation in realized or perceived idiosyncratic risks associated with various municipal securities.

Controls provide additional insights in Table 4. Recall that securities were not

[29]Final sample distribution of issuer types is displayed in Table 8 in the Appendix.

[30]Results are robust to the inclusion of different maturity lengths as the base, see Figure 5.

[31]Variation instead of deviation can be obtained by squaring the standard deviations of issuer and issuance effect.

Table 4: RCM Results, DV = Exempt Yield

	(1)	(2)	(3)
Taxable Yield	**0.676*****	**0.670*****	**0.658*****
	(0.005)	(0.006)	(0.012)
Issuance-level std (θ)		**0.004**	**(0.001)**
		(0.001)	(0.000)
Issuer-level std (λ)		**0.004**	**0.001**
		(0.001)	(0.000)
Coupon Difference	0.095***	0.020***	0.005
	(0.004)	(0.003)	(0.004)
Maturity Size Difference	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Issue Size Difference	-0.000***	-0.000***	-0.000**
	(0.000)	(0.000)	(0.000)
County	0.015	0.004	-0.044**
	(0.021)	(0.025)	(0.022)
State	0.035 *	0.075***	0.107***
	(0.019)	0.026	(0.026)
School District	0.074***	0.082***	
	(0.023)	(0.024)	
Special District	0.343***	0.278***	
	(0.016)	(0.016)	
Town/Township	-0.010	-0.069**	-0.134***
	(0.030)	0.033	(0.029)
Competitive Sale	-0.040***	-0.016	0.159***
	(0.008)	(0.010)	(0.024)
Callable	0.084***	0.037***	-0.012
	(0.019)	(0.010)	(0.022)
Sinking Fund	-0.083***	-0.097***	-0.116***
	(0.026)	(0.015)	(0.044)
Rated	0.003***	0.001*	0.0006
	(0.001)	(0.000)	(0.001)
General Obligation	0.033 **	0.185 ***	0.178 ***
	(0.017)	(0.018)	(0.029)
Insured	-0.027***	0.051***	-0.012
	(0.010)	(0.016)	(0.034)
New (vs. Refunding)	-0.001	0.009	-0.068***
	(0.008)	(0.010)	(0.018)
Demeaned Market Spread	0.175***	0.205***	0.202***
	(0.017)	(0.017)	(0.036)

Notes: (1)-(3): N=6,463, issuances = 1,136, issuers = 577. (4): N=1,354, issuances = 254, issuers = 138. Maturity length/year effects in all models.

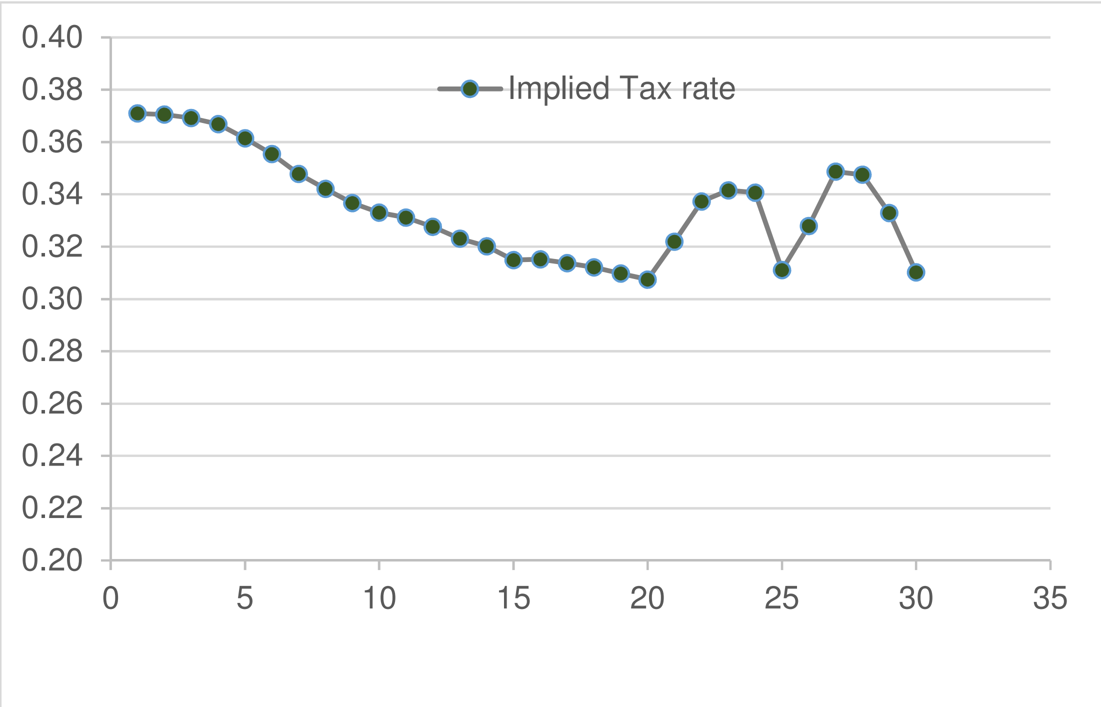
matched on coupon rate, issue, or maturity amount.[32] Control variables not used in matching, coupon, maturity, and issue size differences, are designed so that the key coefficient identifies the one minus the implied marginal tax rates in the absence of any differences between taxable and tax-exempt securities. Recall that the reference group is a new, non-callable, uninsured, unrated, 10-year, general obligation security-pair issued by a city in 2016 where the matched pair have no coupon, maturity, or issue size differences (all covariates are set to zero). Coupon difference is constructed by subtracting taxable coupon rate from the tax-exempt security's coupon rate. Maturity and issue size differences are constructed by subtracting taxable size from the tax-exempt security's respective size (transformed to $\$100,000s$). If the coupon rates on exempt securities are higher (higher coupon difference), this should be reflected in higher exempt yields by design (positive coefficient on the coupon difference variable). If the size of exempt securities is larger (larger size difference) and if there are economies of scale, this should be reflected in lower exempt yields (negative coefficient for the size difference variables). Results are consistent with these expectations.

Remaining control variables have the expected signs. A negative coefficient on the sinking fund provision variable indicates a higher implied marginal tax rate. This is likely due to a reduced idiosyncratic risk as the issuer has to set aside money to repay bondholders at maturity. Presence of a credit rating has a positive but statistically insignificant effect in Model (3), driven by the fact credit ratings do not provide much information after accounting for issuer- and transaction-level effects. Results are therefore robust to inclusion of letter grade identifiers. Insurance and call option have a negative but statistically insignificant effect, likely because these features are built into the taxable and exempt yields identically and there is no theoretical reason to expect differential effects. Sale type has a statistically significant and positive effect in Model (3) but no effect in Model (2), which is consistent with the controversial method of sale literature in public finance which is yet to settle with sale type is most optimal. It is interesting that the GOs have a lower implied marginal tax rate. This may be due to the fact that since the recent global financial crisis, it is yet an unsettled question whether general unlimited obligation bondholders have a preferential treatment in a bankruptcy. This uncertainty has driven some portfolio managers to pay up to purchase revenue bonds where the legal protection is unquestioned in the event of bankruptcy, reducing demand for GOs. Finally, market yields have the expected positive effect on tax-exempt offering yields. This is expected as interest costs tend to rise with prevailing market rates.

Table 8 shows that about 75 percent of the final sample is comprised of special districts. Thus, Model (3) in Table 4 presents the results for the general-purpose government subset of the final matched sample by dropping single-purpose government entities, i.e. special and school districts. These findings imply that investor demand may be higher for debt issued by lower levels of government. Smaller municipalities tend to fare much better in

[32]There are, in fact, 90 observations in the final sample with no coupon or price differences. In this small subsample, the offering yield on taxable and tax-exempt securities is identical, implying a zero implied tax rate. All of the securities in this small subsample are issued by special districts, however. The only plausible explanation for this is under-subscription for the exempt securities. Results are robust to exclusion of these observations.

Figure 5: *Implied Marginal Tax Rate, τ, by Time to Maturity*



Notes: Estimates of $(1 - \beta_1)$ *from Equation 3, the implied marginal tax rate, are obtained by rerunning Equation 3 for each maturity length as the base.*

terms of borrowing costs than state governments. This may be potentially due to the fact that smaller governments issue debt less frequently and generally do not max out their debt capacity whereas states tend to issue bonds more frequently. Further, Pirinsky and Want (2011) show that muni yields are negatively related to local demand and positively related to the local supply of munis. There is likely to be more state-issued debt available in the market at any given time than bonds issued by towns and townships.

Figure 5 and Figure 6 explore the effect of the maturity horizon and the evolution of implied tax rates over time. I calculate the point estimates of the implied marginal tax rates in Figure 5 by rerunning Model (2) in Table 4 for each maturity length as the base. Figure 5 shows that, consistent with Longstaff (2011) and others, implied marginal tax rates for short-term securities are between the top statutory marginal tax rates for individuals (35–39.6 percent) and top corporate tax rate (35 percent). Recall that the highest marginal individual tax rate was revised from 35 to 39.6 percent in 2013 and from 39.6 to 37 percent at the end of 2017. The downward-sloping nature of the implied marginal tax rates is expected given the maturity horizon and the uncertainty in the future income tax rates. However, the slope less steep than the muni puzzle would have suggested. Implied marginal tax rates are above 30 percent for all maturity lengths. Most municipal bonds issued by state and local governments mature in less than 20 years. Longest-term securities are likely to mature in 25, 30, 35, and 40 years. Therefore, there are fewer observations with security pairs maturing in between these ranges in the final sample, which may also explain the large variations in the implied marginal tax rates for longest-term maturities in Figure 5. Given the low supply of, for example, 22-year maturities compared to 20- or 25-year maturities, it is plausible that the implied tax rates are higher for these maturities if demand exceeds supply and thus investors are willing to accept lower returns.

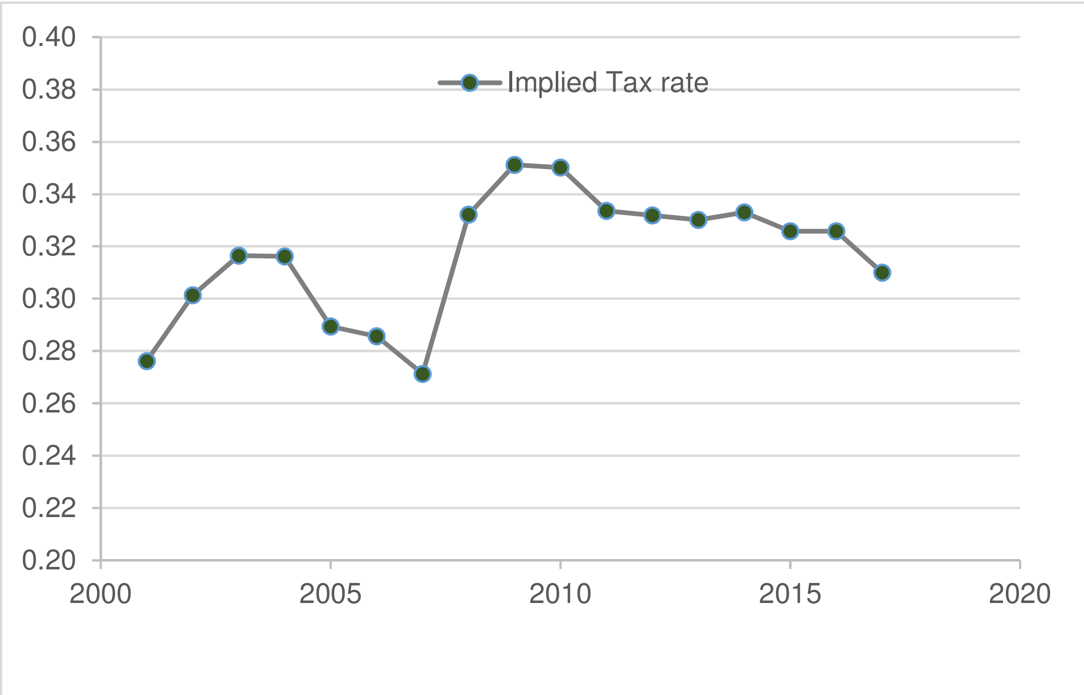
Finally, Figure 6 shows the evolution of the implied marginal tax rate over time. I calculate the point estimates of the implied marginal tax rates in Figure 6 by rerunning Model (2) in Table 4 for each issue year as the base. Results show that implied marginal tax rates are not static but rather seem to be cyclical in nature. Investor demand for munis has grown over the past decade. Figure 6 shows that the implied marginal tax rates rose dramatically during the recent Great Recession of 2007Q4–2009Q2 and have been slowly declining since 2010 when the market began to stabilize. Several factors may be driving these trends. First, the recession and the financial crisis increased the demand for safe and stable assets such as munis. Increased demand is likely to translate into more favorable borrowing costs (higher interest reduction and therefore, higher implied marginal tax rates associated with exempt munis) for state and local governments.

5.3 Discussion

State and local governments may choose to issue tax-exempt and taxable securities simultaneously for regulatory reasons, to attract foreign and/or tax-exempt investors, or simply because of habit. To qualify for a tax-exempt status, issuers have to meet and comply with a multitude of IRS and SEC regulations and meet specific requirements. One caveat is that taxable and tax-exempt securities may attract different investors with fundamentally different income tax profiles, such as foreign investors and mutual funds, who want higher returns and have nothing to gain from the tax exemption of interest income. Without access to data on investors' portfolio composition, it is difficult to identify the exact tax benefits to each bond holder. Nonetheless, underwriters generally have an idea of the profile of the potential investors and bid on new issues or work with issuers to structure the debt accordingly. Assuming investors have access to a pair of taxable and tax-exempt securities identical in almost every other way at the time of issuance, the marginal investor reveals her tax preferences/burden if all debt clears the market.

The value of the exemption to investors is just as important to take into account as the subsidy to state and local governments. Bergstresser and Cohen (2015), using the Surveys

Figure 6: *Evolution of the Implied Marginal Tax Rate, τ*



Notes: Estimates of $(1 - \beta_1)$ from Equation 3, the implied marginal tax rate, are obtained by rerunning Equation 3 for each year as the base.

of Consumer Finances, show that municipal debt holdings of households have changed significantly over time. Despite the increase in the size of municipal debt, ownership has shifted to portfolios of more concentrated investors. Bergstresser and Cohen (2015) show that the share of households holding any municipal debt dropped from 4.6 percent in 1989 to 2.4 percent in 2013 but the share of total debt held by the top 0.5 percent of households rose from 24 percent in 1989 to 42 percent in 2013 and the top 1.2 percent held more than 97 percent of all munis. This shift in the holdings of municipal bonds into portfolios of the wealthiest households implies that the benefit of the exemption is now more concentrated among the wealthiest Americans. This is consistent with my findings that implied marginal tax rates are near the top statutory rates. Bergstresser and Cohen (2015) also show that at least 30 percent of munis are held by households with marginal federal tax rates above 35 percent. These household level estimates further support my findings of implied marginal tax rate of 33–35 percent.

Another relevant point to this study is the difference between marginal and effective tax rates. Due to the effects of various tax exemptions, deductions, and credits for a tax payer within the current tax system, effective tax rates tend to be lower than marginal tax rates for the average taxpayer. An investor with a 25 percent effective tax rate may be less inclined to give up 35 percent of potential interest income. However, the typical muni holder is not an average taxpayer. Piketty et al. (2018) show that the all-inclusive effective tax rate[33] for the top 1 percent of Americans (whose average pre-tax income was $1.3 million in 2014) ranged from 31 percent to 39 percent between 2001 and 2014.[34] These effective tax rate estimates for the top 1 percent coupled with the finding that the muni holders are concentrated at the very top of the wealth distribution provide strong support for my results, the finding that implied marginal tax rates are between $33 - 35$ percent for tax-exempt munis.

6 CONCLUSION

In a decentralized government like the United States, responsibility to fund public infrastructure is shared by federal, state, and local governments. Eliminating the tax-exempt status of subnational debt becomes a policy alternative in periods of budgetary distress, since this tax expenditure costs billions of dollars to the federal government. From a policy perspective, it is important to understand whether state and local governments are recouping the full benefits of this federal subsidy. Existing literature suggests that interest savings accumulated to issuers are smaller than investors' tax savings. I argue that the seemingly high interest rates on exempt municipal securities is partially due to the poorly approximated idiosyncratic risk borne by the bond holders. Results of the random coefficients model show that implied marginal tax rates are $33 - 35$ percent for general-purpose municipal governments, which is consistent with theory and the tax profile of the typical muni investor. Findings indicate that general-purpose municipalities

[33] Taxes on individual incomes, payroll, estates, corporate profits, properties, and sales.

[34] The implied average effective rate then would be 35 percent. See Piketty et al. (2018), Appendix Table G1 available online.

benefit the most from the tax exemption, while special districts benefit the least. Further, implied marginal tax rates vary over time and were higher during the recent financial crisis. These findings imply that if the tax-exemption policy were eliminated or even capped, interest costs for general-purpose governments will likely increase substantially.

My data only capture issuances through the second quarter of 2017. However, it is plausible that the 2017 tax reform, which took effect at the beginning of 2018, will push the implied marginal tax rates further down as investors demand higher returns due to reduced marginal tax rates and therefore reduced tax-reduction benefits associated with municipal bonds. I leave the anticipation and post-implementation effects of the tax-reform on the muni market for future research.

APPENDIX

A Matched and Full Sample Descriptives

Table 5 provides summary statistics for the final matched sample based on the matching criteria described in Section 4.1. The average offering yield for taxable municipal securities is 58 basis points higher than the average yield on exempt securities. The distribution of the implied marginal, τ, shows a mean of 20%, but also a range that is quite wide and includes negative values! Longstaff (2011) explains the intuition for these negative values as driven by states of the economy and countercyclical nature of the after-tax cash flows.

Table 5: Matched Sample Summary Statistics

	N	Mean	Std	Min	Max
Offering Yield (Exempt)	6,463	2.72	1.31	0.10	8.75
Offering Yield (Tax)	6,463	3.30	1.46	0.15	10.00
τ	6,463	0.20	0.13	-0.44	0.79
Market Yield	6,463	2.39	1.27	0.14	5.33
Coupon (Exempt)	6,463	3.63	1.25	0.00	8.75
Coupon (Tax)	6,463	3.94	1.36	0.00	10.00
Offering Price (Exempt)	6,463	104.31	8.36	6.61	131.72
Offering Price (Tax)	6,463	102.85	7.10	4.51	127.31
Issue Size (Exempt, millions)	6,463	67.00	129.00	0.40	1,190.00
Issue Size (Tax, millions)	6,463	62.20	109.00	0.06	826.00
Maturity Size (Exempt, millions)	6,463	3.16	8.10	0.01	181.00
Maturity Size (Tax, millions)	6,463	3.57	11.70	0.01	300.00
Credit Rating	6,463	8.95	9.45	0.00	21.00
General Obligation Bond	6,463	0.25	0.43	0.00	1.00
Call Option	6,463	0.27	0.44	0.00	1.00
Bank-qualified	6,463	0.00	0.00	0.00	0.00
Insured	6,463	0.23	0.42	0.00	1.00
Sinking fund	6,463	0.04	0.20	0.00	1.00
Time to Maturity	6,463	7.79	5.92	1.00	40.00
Rated	6,463	0.48	0.50	0.00	1.00
New Issue (vs. Refunding)	6,463	0.44	0.50	0.00	1.00
Competitive Sale	6,463	0.38	0.48	0.00	1.00

Table 6: Unmatched Exempt Sample Summary Statistics

	N	Mean	Std	Min	Max
Offering Yield	692,397	3.19	1.26	0.03	14.00
Market Yield	692,397	2.86	1.25	0.14	5.99
Coupon Rate	692,397	4.08	0.99	0.00	14.00
Offering Price	692,397	105.01	6.88	4.00	149.95
Issue Size (millions)	692,397	76.90	187.00	0.01	12,900.00
Maturity size (millions)	692,397	4.05	23.50	0.01	12,900.00
Credit Rating	692,397	12.21	9.02	0.00	21.00
General Obligation	692,397	0.47	0.50	0.00	1.00
Call Option	692,397	0.47	0.50	0.00	1.00
Insured	692,397	0.35	0.48	0.00	1.00
Sinking Fund	692,397	0.07	0.26	0.00	1.00
Time to maturity	692,397	10.45	6.48	0.00	45.00
Rated	692,397	0.65	0.48	0.00	1.00
New Issue	692,397	0.50	0.50	0.00	1.00
Competitive Sale	692,397	0.46	0.50	0.00	1.00

Table 7: Unmatched Taxable Sample Summary Statistics

	N	Mean	Std	Min	Max
Offering Yield	59,279	3.68	1.56	0.07	14.72
Market Yield	59,279	2.61	1.35	0.14	5.99
Coupon Rate	59,279	3.90	1.51	0.00	14.00
Offering Price	59,279	101.02	3.23	13.72	140.23
Issue Size (millions)	59,279	41.10	80.30	0.01	2260.00
Maturity size (millions)	59,279	3.70	13.70	0.01	1000.00
Credit Rating	59,279	0.56	0.50	0.00	1.00
General Obligation	59,279	0.30	0.46	0.00	1.00
Call Option	59,279	0.32	0.47	0.00	1.00
Insured	59,279	0.26	0.44	0.00	1.00
Sinking Fund	59,279	0.17	0.37	0.00	1.00
Time to maturity	59,279	9.04	7.32	0.00	45.00
Rated	59,279	0.56	0.50	0.00	1.00
New Issue	59,279	0.51	0.50	0.00	1.00
Competitive Sale	59,279	0.38	0.49	0.00	1.00

Table 8: Issuer Type Distribution

	Frequency	Percent	Cumulative
	Matched Sample		
City	697	10.78	10.78
County	224	3.47	14.25
State	331	5.12	19.37
School District	206	3.19	22.56
Special District	4903	75.86	98.42
Town/Township	102	1.58	100
Total	6,463		
	Unmatched Exempt Sample		
City	78,445	11.33	11.33
County	45,100	6.51	17.84
State	22,807	3.29	21.14
School District	165,032	23.83	44.97
Special District	360,809	52.11	97.08
Town/township	20,204	2.92	100.00
Total	692,397		
	Unmatched Taxable Sample		
City	6,673	11.26	11.26
County	2,705	4.56	15.82
State	1,878	3.17	18.99
School District	4,410	7.44	26.43
Special District	42,172	71.14	97.57
Town/township	1,441	2.43	100.00
Total	59,279		

A.1 Robustness Checks

A.1.1 Implied Rate, τ, as the Dependent Variable

Recall that theory predicts an implied marginal tax rate of about close to 35 percent for a typical longer-term muni, but public finance literature finds this rate to be about 20 - 25 percent. I first run an ordinary GLM found in many muni puzzle studies:

$$\tau_{ijt} = \alpha + \beta X_{ijt} + \epsilon_{ijt} \tag{4}$$

where τ is derived from Equation 1 and X is a vector of covariates. I argue that this design results in sufficient loss of granularity to produce the "muni puzzle" findings. Using this flawed design, I find the same results with my matched sample in Table 9.

The naive implied marginal tax rate, τ, the binary relationship between matched taxable and exempt offering yields, is regressed on several important covariates, with standard errors clustered at the issuer level. The key variable of interest in this model is the intercept, which provides the implied marginal tax rate for the reference group, a new, non-callable, uninsured, unrated, 10-year, revenue bond security pair issued by a city in 2014, where the matched pairs have no coupon, price, or size differences (all covariates are set to zero). The reference group is chosen to represent a typical security in the sample that makes the interpretation of results most straightforward. Variable definitions are listed in Table 1. Models (1) and (2) in Table 10 show that as important covariates are neglected, the muni puzzle becomes more severe. The full model, model (3), shows an implied marginal tax rate of 25 percent for the reference group, consistent with previous studies. Note that positive coefficients on the covariates increase the spread between the taxable and tax-exempt yields, thereby, increasing the implied tax rate. Control variable definitions, interpretations, and the reference group are same as in the main model.

A.1.2 GLM model without unobserved effects

I also run the following GLM model, which is equivalent to Equation 3 where $\theta_j = 0$ and $\lambda_k = 0$ (no control for time-varying unobserved effects):

$$y^E_{ijkt} = \beta_1 y^T_{ijkt} + \beta_2 X_{ijkt} + \beta_3 Z_{ijkt} + \epsilon_{ijkt} \tag{5}$$

First, matching on observable security and issuer characteristics and controlling for coupon, maturity size and issue size differences improves the implied marginal tax rate estimate to 28 percent (one minus the coefficient) for a typical long-term muni bond in Model (1). Adding additional security level controls improves the estimate only slightly in Model (2). Model (3) in Table 10 supports the claim that the issuer type matters in estimating the implied marginal tax rates. Control variable definitions, interpretations, and the reference group are same as in the main model. However, an ordinary GLM model ignores issuer- and issuance-level unobserved effects which may also vary over time. It turns out that the unobserved effects are small enough that the difference between the key coefficients in the GLM and RCM models is less than two basis points.

Table 9: GLM Results, Dependent Variable = τ

	(1)	(2)	(3)
Intercept	**0.21*** **	**0.22*** **	**0.27*** **
	(0.01)	(0.01)	(0.02)
Issuer Type Reference Group = City			
County			0.01
			(0.02)
State			-0.03
			(0.02)
School District			0.02
			(0.02)
Special District			-0.06***
			(0.02)
Town/Township			0.06**
			(0.02)
Coupon Difference	-0.02***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)
Maturity Size Difference	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Issue Size Difference	0.00**	0.00*	0.00*
	(0.00)	(0.00)	(0.00)
Competitive Sale		0.02**	0.01
		(0.01)	(0.01)
Callable		0.00	-0.09
		(0.01)	(0.01)
Sinking Fund		0.03***	0.04***
		(0.01)	(0.01)
Rated		-0,03***	0.03***
		(0.01)	(0.01)
General Obligation		0.08***	0.02
		(0.01)	(0.02)
Insured		0.01	0.01
		(0.01)	(0.01)
New (vs. Refunding)		0.00	0.00
		(0.01)	(0.01)
Demeaned Market Spread		-0.01	-0.01
		(0.01)	(0.01)
R^2	0.42	0.49	0.51

Notes: N=6,463, issuances = 1,138, issuers = 579.
Maturity length and year indicators are included in all models.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. *Standard errors in parentheses.*

Table 10: GLM Results, DV = Exempt Offering Yield

	(1)	(2)	(3)
Taxable Yield	**0.72*****	**0.71*****	**0.67*****
	(0.01)	(0.02)	(0.02)
Issuer Type Reference Group = City			
County			0.01
			(0.07)
State			0.03
			(0.07)
School District			0.08
			(0.06)
Special District			0.34***
			(0.05)
Town/Township			-0.01
			(0.06)
Coupon Difference	0.10***	0.11***	0.09***
	(0.02)	(0.02)	(0.01)
Maturity Size Difference	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)
Issue Size Difference	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)
Competitive Sale		-0.05**	-0.04*
		(0.02)	(0.02)
Callable		0.14***	0.09*
		(0.05)	(0.05)
Sinking Fund		-0.10	-0.08
		(0.06)	(0.06)
Rated		0.12***	0.06***
		(0.02)	(0.02)
General Obligation		(0.25)***	0.03
		(0.03)	(0.05)
Insured		-0.03	-0.03
		(0.04)	(0.04)
New (vs. Refunding)		-0.01	0.00
		(0.02)	(0.02)
Demeaned Market Spread		0.12**	0.18***
		(0.05)	(0.05)

Notes: N=6,463, issuances = 1,138, issuers = 579.
Maturity length and year indicators are included in all models.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. *Standard errors in parentheses.*

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