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Tax distortions and bond issue pricing☆

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ABSTRACT

Original issue premium (OIP) bonds are the norm in the US tax-exempt market but very rare in the taxable market. A tax subsidy helps explain this disparity. Unlike bonds issued at par or discount, the price of OIP bonds can fall and yet remain above par, providing secondary market buyers with more tax-exempt coupon and less taxable market discount gain. The subsidy for OIP bonds explains additional, previously undocumented empirical facts. In a calibration exercise, the subsidy's expected cost to the U.S. Treasury is estimated at $1.7 billion per year.

1. Introduction

Tax incentives affect investors' portfolio and trading choices, asset prices, and ultimately issuers' financing choices. If these incentives are not the expression of optimal policies, the resulting distortions can cause inadvertent fiscal transfers, waste of real resources, and a suboptimal allocation of capital. The US municipal bond market is a unique setting to observe tax distortions. It is the world's only sizable market for tax-exempt assets, with a total capitalization of nearly $4 trillion. The exemption of interest income attracts almost exclusively taxable investors, magnifying the effect of any remaining taxes.[1]

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[1] The finance literature has highlighted numerous tax-induced municipal bond market quirks. A classic puzzle regards the relative slopes of the taxable and tax-exempt yield curves, with the tax-exempt curve being "too steep" (Trzcinka, 1982; Chalmers, 1998; Wang et al., 2008; Jordan, 2012). Green (1993) argues that a form of tax arbitrage explains this relation. Nanda and Singh (2004) argue that the prevalence of bond insurance is also explained by tax arbitrage. Starks et al. (2006) find a "January effect" for tax-exempt bond closed-end funds, consistent with an incentive to defer gains and realize losses that does not exist for taxable bonds.

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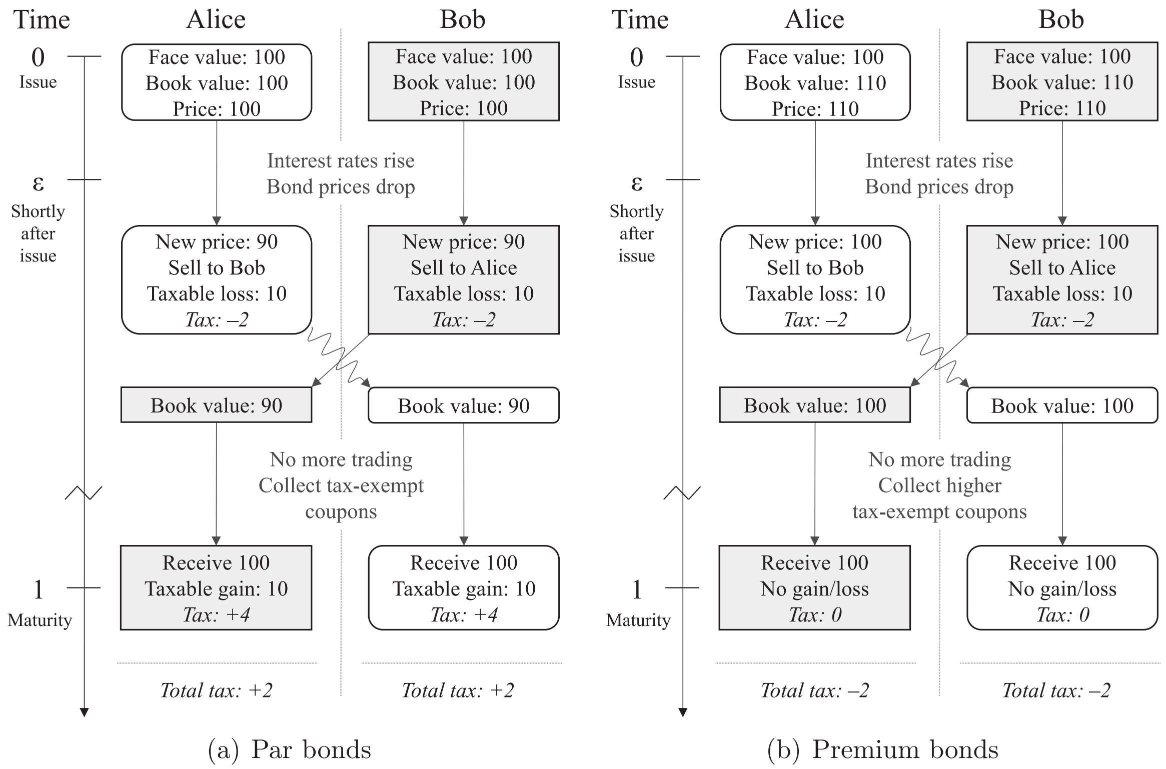

Fig. 1. The original buyer of a tax-exempt bond who later sells the bond at a loss receives a tax rebate at the capital gains rate (here, 20%). If the bond was issued at par, the new buyer obtains a gain upon maturity, taxed as ordinary income (40%). If the bond was issued at a premium, the buyer obtains a higher amount of tax-exempt coupon instead of the taxable gain.

This paper shows an important, tax-driven municipal market peculiarity: the prevalence of bonds issued with a price above par, known as original issue premium (OIP) bonds. In 2015, 94% of all noncallable tax-exempt bonds were issued at a premium. These premiums are large: the average ten-year bond was issued at a price of 119 per 100 face value. By contrast, premium bonds are rarely offered in the taxable market. In 2015, less than 1% of corporate bonds, 17% of taxable municipal bonds, and 1% of US Treasury bonds were issued at a premium, with almost all the remainder issued near par.[2] In this paper, I propose a novel explanation for this striking difference: the US tax code subsidizes premium tax-exempt bonds. I estimate this subsidy's expected cost to the US Treasury to be about $1.7 billion per year.

If a tax-exempt bond is bought and held to maturity, all investor income is tax exempt, and the bond's issue price is inconsequential. The subsidy materializes only when bonds are sold at a loss in the secondary market. Consider the case of a bond issued at par, i.e., with an issue price equal to face value. Suppose interest rates rise and an investor buys the bond at a discount to face value. When the bond matures and the issuer pays off the full face value, the buyer realizes a gain. This gain is labeled a *market discount gain* and is taxed as ordinary income, regardless of whether the bond itself is taxable or tax exempt.[3] Unlike par bonds, OIP tax-exempt bonds are tax efficient simply because their price can fall and yet remain above par, avoiding the market discount label and the associated tax.[4]

Fig. 1(a) illustrates a concrete example. At time 0 two identical investors, Alice and Bob, buy equal amounts of two identical, risk-free tax-exempt bond issues. The bonds are issued at par, i.e., with a coupon rate equal to the yield and a price equal to face value (normalized to 100). Shortly after, at time ε, yields rise and the market prices of the bonds drop to 90. The two investors could simply

Li (2006) points out the existence of dominated prices below the so-called de minimis boundary, an artifact of tax accounting. Ang et al. (2010) show empirically that bond yields jump around this boundary.

[2] Callable bonds are excluded from the empirical analysis because the call option is a confounding factor in the choice of an issue price. However, the presence of a call feature does not affect the basic intuition that some premium is tax efficient. In 2015, 65% of callable tax-exempt bonds were also issued at a premium, compared to 1% of taxable municipal bonds and less than 1% of corporate and US Treasury bonds.

[3] Internal Revenue Code Section 1276(a)(1).

[4] For simplicity, this introductory discussion only compares bonds issued at par and premium, ignoring original issue discount (OID) bonds. Paragraphs (2) and (4) of IRC Section 1278(a) specify that for OID bonds, a market discount exists when the purchase price is below the original issue price plus accreted OID, instead of below par. This rule renders the treatment of OID bonds economically equivalent to that of bonds issued at par. However, there is no corresponding paragraph for OIP bonds in Section 1278(a) or elsewhere. As a result, the price of a bond issued at a premium must drop below par before the market discount rules are triggered.

hold their bonds to maturity and never realize any taxable gain or loss. Instead, they sell their respective bonds to one another, realizing a beneficial tax loss while leaving their portfolios practically unchanged. Through the life of the bonds, Alice and Bob receive only tax-exempt coupon income. Upon maturity, having paid 90 for the bonds, they receive 100 cash, realizing a taxable market discount gain of 10. The present value tax consequences of trading to realize the loss can be positive or negative, depending on the bond's maturity and the discount rate.

Fig. 1(b) illustrates the parallel case in which the bonds are issued at a premium, i.e., with a coupon rate higher than the yield, resulting in a price of 110. When yields rise, the price drops to 100. Alice and Bob still sell their bonds to one another, realizing a loss of 10 with the associated tax benefit. Through the life of the bonds, the two investors receive a larger amount of tax-exempt coupon income because the premium bonds have a higher coupon rate than the par bonds. Upon maturity, having paid 100 for the bonds, they receive 100 cash, recording no additional gain or loss. Alice and Bob's total tax bill is negative because they realized a beneficial tax loss and never paid any taxes—an unambiguously superior outcome.

Taxable premium bonds do not have a similar tax advantage. Because coupon income is taxable as well, there is no tax-related reason to prefer coupon income to market discount gains. In fact, OIP taxable bonds are less tax efficient than par bonds, because coupon income is taxed in the current year, whereas market discount gains are taxed only when realized. This is consistent with the empirical fact that OIP taxable bonds are rare.

Since investors are willing to pay more for tax-efficient bonds, a rational issuer structures its bonds to maximize the expected present value of investor tax benefits as a fraction of issue proceeds. A high issue price benefits the investor by reducing the likelihood of a market discount. However, a high issue price (a high coupon) also harms the investor by decreasing the bond's price volatility. Price volatility is valuable because it increases the expected returns for all tax-timing strategies, including those that exist regardless of issue price (Constantinides and Ingersoll, 1984). The tug-of-war of these two forces determines the optimal issue price. In Section 2, I use a near-universal sample of noncallable bonds to show two additional empirical facts that are consistent with these dynamics. These two facts are previously undocumented.

The first fact concerns the time-series behavior of coupon rates. The coupon rate of new taxable issues closely tracks their yield, resulting in the consistent issuance of bonds at or near par. By contrast, the coupon rate of new tax-exempt issues moves less than one-to-one with their yield. This lack of sensitivity can be explained as a consequence of mean reversion in interest rates. When interest rates are low, they are expected to rise, and bond prices are expected to fall. To keep the price from falling below par, investors demand a larger issue premium, i.e., a coupon rate that is higher relative to the yield. When interest rates are high, investors expect bond prices to rise and therefore do not need as much protection against market discount. Thus, the benefit of a high coupon (protection) varies with the level of interest rates, whereas the cost (reduced price volatility) is approximately constant. Stronger demand for high coupons when interest rates are low dampens fluctuations in the coupon rate relative to the yield.

The second fact is that longer-maturity bonds are usually issued with larger premiums. In 2015, mean issue prices were 102, 113, and 119 for one-, five-, and ten-year bonds, respectively. Because the price of longer-term bonds is more volatile, a larger issue premium is required to ensure that the price does not fall below par.

Although the tax code does contain an incentive to issue premium tax-exempt bonds, a reasonable question is whether the incentive is large enough to justify their widespread issuance. In Section 4, I show that the benefits of issuing premium bonds are substantial under a reasonable calibration. From the perspective of the issuer, an optimally issued ten-year noncallable bond can be worth up to 1.3% more than a par bond—an amount comparable to the cost of issuance itself. In aggregate, the expected cost to the US Treasury is estimated at approximately $1.7 billion per year. This cost is defined as the present value of tax arbitrage created by issuing premium bonds, as compared to par bonds.

An alternative motive for issuing premium bonds is creative accounting. Whitaker and Ergungor (2015) argue that premium bonds are issued as a workaround to self-imposed debt limits.[5] Kalotay argues that bonds with a par call option are issued at a premium to inflate the apparent "savings" that justify a later refunding.[6] In turn, refundings can serve as yet another way around borrowing limits (Ang et al., 2017). These additional motives may add to state and local governments' incentive to issue premium bonds, but alone they do not explain the unique empirical facts presented in this paper. The debt limit motive does not explain the difference between taxable and tax exempt bonds, and the refunding motive only applies to callable bonds. Creative accounting motives and tax arbitrage motives are not mutually exclusive, but rather complementary. The tax code creates costly distortions, and these distortions reward lack of fiscal discipline at the state and local level.

2. Empirical evidence

This section shows some empirical facts concerning the structuring of new bond issues. Practitioners are aware of

[5] Debt limit rules appear to be unaffected by the Governmental Accounting Standards Board (GASB) 34 requirement of accrual accounting, and therefore a premium bond issued at 120 contributes only 100 towards the debt limit. In a letter to a school district, California's attorney general decries "the practice of artificially inflating the interest rate" to obtain "additional bond proceeds over and above what the voters authorized" (Saskal, R., 2011. California schools on notice. The Bond Buyer. Available at https://www.bondbuyer.com/news/california-schools-on-notice). Media observers have proposed issuing premium bonds as a workaround to the United States debt ceiling problem (Levine, M., 2013. Mint the premium bonds! BloombergView. Available at http://www.bloomberg.com/view/articles/2013-10-02/mint-the-premium-bonds-).

[6] Kalotay, A., 2012. The allure of 5% bonds: Coupon levitation creates magical savings. The Bond Buyer. Available at http://kalotay.com/sites/default/files/municipal-articles/Allure%20of%205pct%20bonds.pdf.

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the prevalence of premium bonds in the tax-exempt market and their rarity in the taxable market. However, two other facts regarding tax-exempt bonds appear to be previously undocumented: the upward-sloping shape of the term structure of issue prices and the reduced sensitivity of coupon rates to yields.

2.1. Data

I assemble a comprehensive collection of static information on US bonds. Each observation corresponds to a distinct security. I join 181,479 corporate bonds from the Mergent Fixed Income Securities Database (FISD) with 137,553 taxable municipal bonds and 3,393,114 tax-exempt municipal bonds from the Mergent Municipal Bond database.[7] The large number of tax-exempt bonds is due to the large number of small issuers, as well as the fact that each issue is sliced into multiple securities with different maturities and smaller principal amounts.

Information on all issuance auctions of US Treasury obligations is available from 1980 to the present day on the TreasuryDirect website. Excluding the reopenings of existing securities, I collect a list of 1393 notes and bonds (henceforth “bonds”). Treasury bills, obligations with maturity less than two years, are always issued with a zero coupon and are therefore not of interest for the purposes of this study.

The data is cleaned using several filters. Starting in 2000, Mergent provides near-universal coverage; the total issuance amounts inferred from Mergent match or exceed the market-wide totals reported by the Securities Industry and Financial Markets Association (SIFMA) and earlier by the Federal Reserve. Thus, to maximize coverage, the sample of bonds is restricted to those issued from 2000 to 2015 (the latest complete vintage at the time of writing).[8] Putable bonds, convertible bonds, bonds in currency other than US dollars, and bonds with an issue price or maturity date that are either missing or meaningless are also excluded.

Finally, my analysis is restricted to noncallable bonds of maturities of ten years or less because the rest of the universe has important confounding factors. Callable bonds are excluded altogether because the call option affects the optimal issue price in several ways, the modeling of which is outside the scope of this study.[9] Excluding callable bonds eliminates 95% of long-term tax-exempt bonds, which are callable after ten years; the remaining 5% is a special subset that is likely to suffer from sample selection bias and is therefore excluded. The final dataset contains 659 Treasury bonds, 64,628 corporate bonds, 61,415 taxable municipal bonds, and 1,164,087 tax-exempt municipal bonds.

Most of the statistics in the paper are reported on a value-weighted basis. Greater weight is given to bonds with larger issue amounts to better reflect the reality of the market from the points of view of an investor and of the tax authority. All findings are qualitatively similar on an equal-weighted basis, although less extreme (for instance, using equal weights, premium bonds in 2015 were 83% of tax-exempt bonds instead of 94%).

2.2. Premium bonds are the norm in the tax-exempt market

Fig. 2 plots the distribution of noncallable bond issue prices in 2015, the most recent complete year. The plot is broken down by bond type (Treasury, corporate, taxable municipal, and tax-exempt municipal). Table 1 reports more comprehensive summary statistics using the same data. The top panel is calculated using the whole sample (2000–2015) and the bottom panel using only 2015. The table has five columns: discount, small discount, par, small premium, and premium. Small discount and small premium are defined as less than 0.25 per 100 face value times the number of whole years remaining until maturity.[10] Discounts or premiums of this size could be due to rounding of the coupon rate, rather than being intentional.

Each panel’s first row shows the distribution of US Treasury issue prices. Treasury bonds provide a natural benchmark; unlike all other issuers, Treasury has no advantage from issuing tax-efficient bonds. Most Treasury bonds are issued at small discounts. The reason for this regularity is that Treasury sets coupon rates in discrete increments and explicitly aims to produce an issue price closest to, but not above, par.[11]

Other taxable issuers also consistently issue at or near par. Corporate issuers appear to follow a policy similar to that of the US Treasury. As a result, only a small fraction of corporate bonds are issued at a premium; the rest is issued either at par or with a small discount, in both the full sample and in the most recent year. Taxable municipal issuers seem to target an issue price as close as possible to par. Roughly two-thirds of taxable municipal bonds are

[7] The Mergent FISD database is available, e.g., via Wharton Research Data Services (WRDS). The Mergent Municipal Bond data can be obtained directly from Mergent (http://www.mergent.com/).

[8] Based on the incomplete data prior to 2000, it appears that issuance of premium bonds began in earnest in 1993, although prior tax rules already contained an incentive. Because I do not attempt to fully model all the factors that enter the choice of an issue price, it is difficult to say what suppressed the issuance of premium bonds prior to 1993. Interestingly, however, in 1993 the treatment of market discount gains changed from capital gains to ordinary income, substantially increasing the existing incentive.

[9] For a given call price, the issue price determines the moneyness of the call option and therefore the value of the bond, its expected maturity, and the optimal exercise strategy. A large premium would essentially force the issuer to call the bond, making the call option pointless. Further, a call option reduces the expected value of loss harvesting, both by altering the tax accounting rules for the calculation of capital gains and losses and by reducing the bond’s price volatility. Brown (2011) argues that the call option itself is advantageous from a tax standpoint.

[10] For taxable bonds, an issue discount of less than 0.25 per 100 face value times the number of whole years remaining until maturity is labeled de minimis and treated as a capital gain [Internal Revenue Code Section 1273(a)(3)]. For tax-exempt bonds, issue discount is treated as tax-exempt interest regardless of size [Section 1288(b)(1)]. Table 1 includes a symmetric “small premium” column, but the tax code contemplates no such thing as a “de minimis premium.”

[11] The only Treasury bonds issued at a premium are reopenings of existing securities (excluded from the sample) and inflation-protected securities with negative real yields (1% of all bonds by value).

Table 1
Value-weighted distribution of bond issue price by issuer type.
Par bonds are issued with a price of exactly 100. Small discount and small premium are defined as less than 0.25 per 100 face value times the number of whole years remaining until maturity (see footnote [10]). Sample: all noncallable bonds issued between 2000 and 2015. Source: TreasuryDirect, Mergent FISD, and Mergent Municipal Bond (see Section 2.1).

Issuer type	Discount	Small discount	Par	Small premium	Premium	N. Obs.
Full sample (2000–2015)						
Treasury	0.00	96.80	2.00	0.44	0.76	659
Corporate	0.73	70.68	25.96	1.12	1.52	64,628
Municipal taxable	1.82	8.63	65.73	11.02	12.81	61,415
Municipal tax exempt	0.72	4.54	6.02	4.66	84.05	1,164,087
Most recent year (2015)						
Treasury	0.00	92.83	5.89	0.00	1.28	51
Corporate	0.00	73.83	25.86	0.31	0.00	3,897
Municipal taxable	1.19	3.09	73.34	5.63	16.74	4,953
Municipal tax exempt	0.26	0.65	3.77	1.26	94.05	76,636

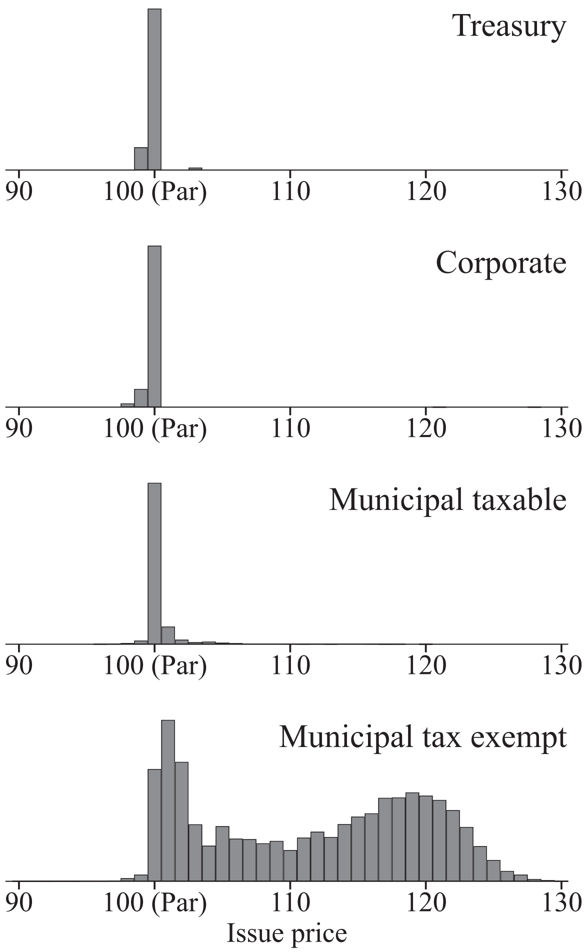

Fig. 2. Issue price distribution by issuer type. Sample: all noncallable bonds issued in 2015. Source: TreasuryDirect, Mergent FISD, and Mergent Municipal Bond (see Section 2.1).

issued exactly at par, with most of the rest at small premiums and discounts. By contrast, approximately 84% of tax-exempt bonds are issued at a premium (89% including small premiums).

2.3. Tax-exempt bond coupon rates are less sensitive to yields

Fig. 3 is a quarterly frequency plot of the average coupon rate and issue yield for new noncallable issues, broken down by tax status and maturity. Each data point is calculated as the value-weighted average of all bonds issued in that quarter. The left column of Fig. 3 (taxable bonds) aggregates corporate bonds and taxable municipal bonds whose individual plots look substantially identical. Taxable bond coupons closely track yields regardless of maturity. Treasury bonds also look substantially identical, but they are excluded because their coupon rates track yields as a matter of explicit policy. The right column of Fig. 3 shows that the relation between coupon rate and yield is weaker for tax-exempt bonds, especially for longer-term ones.

Fig. 4 shows a scatter plot of the same data points. The β coefficients reported on the legend are estimated from an ordinary least squares (OLS) regression of coupon on yield with separate intercept and slope coefficients for each combination of taxable status and maturity class.[12] The regression equation is

$$Coupon_i = \sum_{e\in\{T,E\}} \sum_{m\in\{S,M,L\}} (\alpha_{e,m} + \beta_{e,m} \cdot Yield_i) \cdot \mathbb{I}_i^{(e,m)} + \varepsilon_i, \quad (1)$$

where the subscript e specifies the tax status of the bonds (taxable, T, or tax exempt, E), and the subscript m specifies the maturity class: less than two years (S, or “short”); between two and five years (M, or “medium”); and between six and ten years (L, or “long”). $\mathbb{I}_i^{(e,m)}$ is an indicator variable that is one if observation i has tax status e and maturity class m. The resulting estimates are also reported in the first column of Table 2.[13]

[12] This regression does not attempt to identify causality; it is reported to help the reader determine that the visually striking difference in Fig. 3 and 4 is statistically significant. In this exercise, I simply assume that the issuer chooses a coupon taking the expected issue yield as given.

[13] These coefficients are the same as would be estimated in six separate univariate regressions of *Coupon* on *Yield* and a constant term. However, by running the six regressions as one, the statistical significance of the differences between pairs of coefficients can be easily computed.

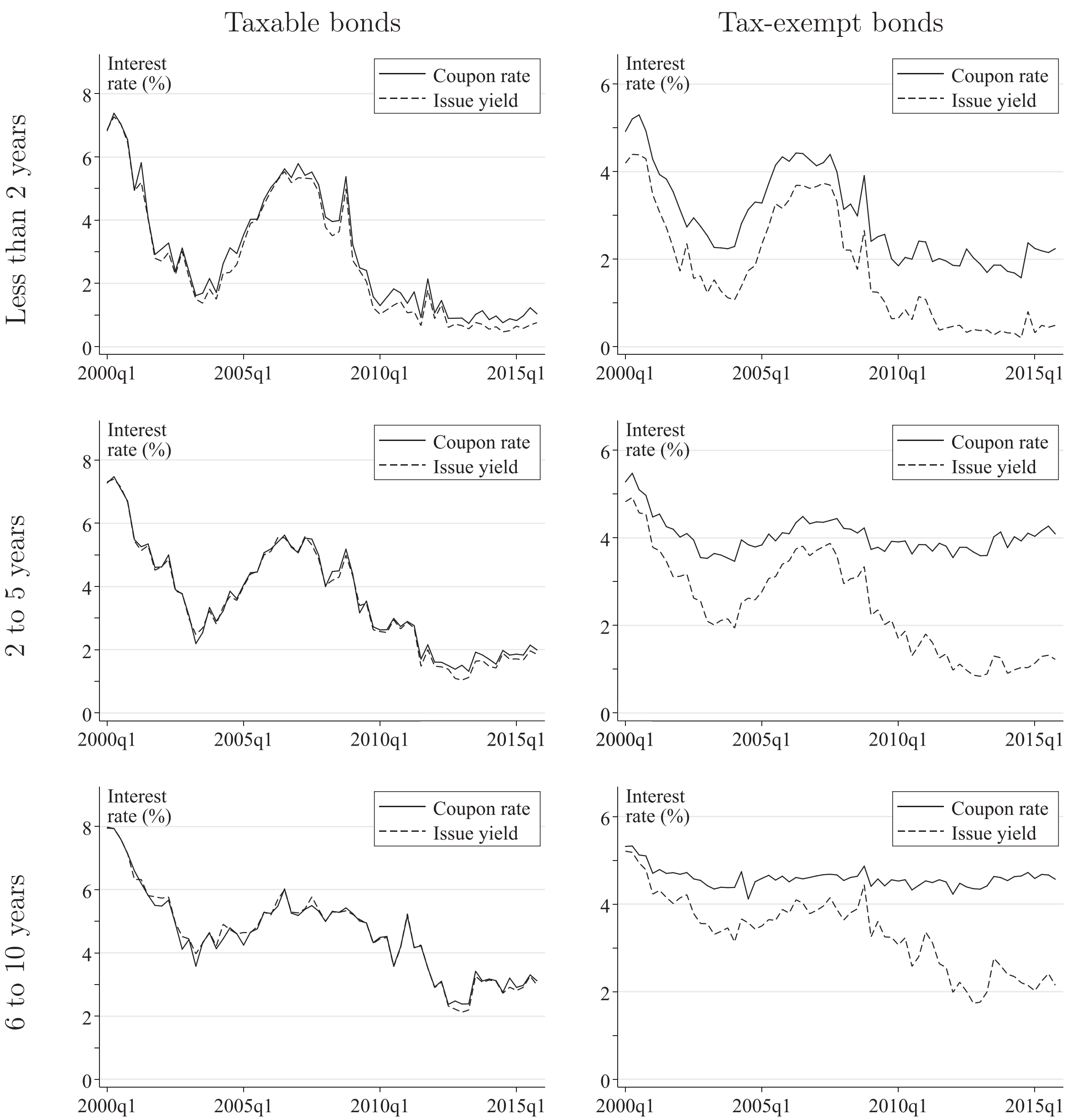

Fig. 3. Value-weighted average of coupon rate and issue yield. Each row corresponds to a maturity class: less than two years, two to five years, and six to ten years. Each column corresponds to a tax status: taxable and tax exempt. Taxable bonds include taxable municipal bonds and corporate bonds, both of which show the same pattern when plotted individually. Treasury bonds are excluded because coupon rates track yields as a matter of policy. Sample: corporate and municipal noncallable bonds issued between 2000 and 2015 with maturity up to ten years. Data: Mergent FISD and Mergent Municipal Bond (see Section 2.1).

If issuers simply aimed at issuing par bonds, they would set the coupon equal to the expected issue yield. In this case, the relation between coupon and yield would be one-to-one with all data points lying on, or very close to, the 45-degree line. This relation would be unaffected by bond maturity.

For taxable bonds, this relation is evident. The slope coefficients for the three maturity classes are close to one and not statistically different from one another. The three coefficients are equal to 0.97, 0.97, and 0.96, meaning that a 1% higher yield is associated with a 0.96% or 0.97% higher coupon rate.

Conversely, for tax-exempt bonds, one additional point of yield is associated with less than one additional point of coupon. The relation still appears monotonic, but the slope is less than one, and it is less steep for longer-maturity bonds. For bonds with maturities less than two years, a 1% higher yield is associated with only a 0.77% higher coupon

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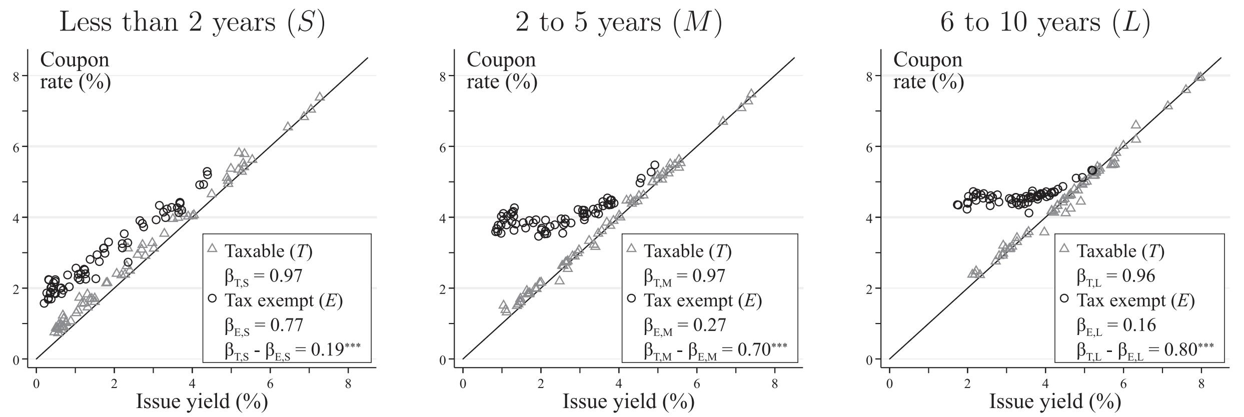

Fig. 4. Coupon rate as a function of issue yield. Both yield and coupon rate are quarterly value-weighted averages. Each graph compares taxable and tax-exempt bonds for a different maturity class: less than two years (S), two to five years (M), and six to ten years (L). The reported β coefficients are estimated from Eq. (1). Because all six coefficients are simultaneously estimated, it is possible to report the statistical significance of the differences between pairs of coefficients. Stars indicate significance at the 90% (*), 95% (**), and 99% (***) levels. Sample: corporate and municipal noncallable bonds issued between 2000 and 2015 with maturity up to ten years. Data: Mergent FISD and Mergent Municipal Bond (see Section 2.1).

Table 2
OLS regression of coupon rate on issue yield.

Both yield and coupon rate are quarterly value-weighted averages. The sample consists of 384 observations: 64 quarters (2000q1–2015q4) by three maturity classes (zero to one years, S; two to five years, M; and six to ten years, L) by two taxable statuses (taxable, T; and tax exempt, E). Specification (1) is the baseline OLS regression (Eq. (1)). Specification (2) is the same as Eq. (1) but using changes (first differences) instead of levels. Specifications (3) and (4) separately examine positive changes and negative changes, respectively. Group-specific constant terms are omitted. t-statistics are reported in parentheses under the coefficients. Stars indicate significance at the 90% (*), 95% (**), and 99% (***) levels. Sample: corporate and municipal noncallable bonds issued between 2000 and 2015 with maturity up to ten years. Source: Mergent FISD and Mergent Municipal Bond (see Section 2.1).

Dependent variable: Coupon rate Independent variable: Issue yield				
	(1)	(2)	(3)	(4)
Maturity class: 0–1 years				
$\beta_{T,S}$	0.967***	1.036***	0.879***	0.943***
	(108.275)	(26.609)	(11.219)	(14.165)
$\beta_{E,S}$	0.774***	0.678***	0.981***	0.871***
	(42.697)	(5.259)	(11.260)	(7.133)
Maturity class: 2–5 years				
$\beta_{T,M}$	0.970***	1.038***	0.827***	1.018***
	(128.772)	(25.752)	(5.983)	(16.421)
$\beta_{E,M}$	0.269***	0.497***	0.720***	0.302***
	(6.911)	(8.744)	(6.685)	(3.417)
Maturity class: 6–10 years				
$\beta_{T,L}$	0.962***	0.943***	0.823***	0.878***
	(77.875)	(22.023)	(9.951)	(15.199)
$\beta_{E,L}$	0.159***	0.362***	0.328***	0.305***
	(4.793)	(9.696)	(3.716)	(3.819)
N. Obs.	384	378	134	166
Adj. R^2	0.998	0.825	0.884	0.922

rate ($\beta_{E,S} = 0.77$). The coupon rates of bonds with maturities of two to five years are significantly less sensitive ($\beta_{E,M} = 0.27$), and those of bonds with maturities of six to ten years are even less sensitive ($\beta_{E,L} = 0.16$). The three slope coefficients are different from one, from their taxable counterparts, and from one another, at the 5% significance level or better.

Table 2 reports the results of three additional specifications. Specification (2) is the same regression as Eq. (1) but using changes (first differences) instead of levels. Using changes instead of levels reduces the likelihood that the results are driven by spurious correlation. Using changes also makes it possible to separately examine positive changes and negative changes. This is done in Specifications (3) and (4), respectively. The results hold qualitatively in both subsamples: when market-wide yields decline, the coupon rate of newly issued tax-exempt bonds decreases by less than the decline in yields; when yields rise, the coupon rate also rises by less. This result suggests that the reduced sensitivity finding is not driven by the secular drop in interest rates that took place during the sample period, as it also holds in subperiods characterized by rising yields. Rather, the finding that coupons rise less than yields is consistent with a dynamic tax arbitrage model. In such a model, raising the coupon is not costless because it reduces the bond's price volatility and therefore the expected value of tax timing. This explanation is examined in detail in Section 4.

2.4. The term structure of issue prices

Tax-exempt issuers' behavior exhibits interesting variation as a function of maturity in the cross-section: for noncallable bonds up to ten years' maturity, issue premium is an increasing function of time to maturity.

Fig. 5 displays the distribution of tax-exempt bond issue prices within each maturity. For instance, the box plot labeled "1" represents the distribution of bonds of one-year maturity. The box contains the middle 50% of the value-weighted empirical distribution. Only outliers are outside the area enclosed by the whiskers (Cox, 2009). The number of observations used to draw each box is stated above the upper whisker. For instance, the "1" box plot is drawn using 117,691 observations.

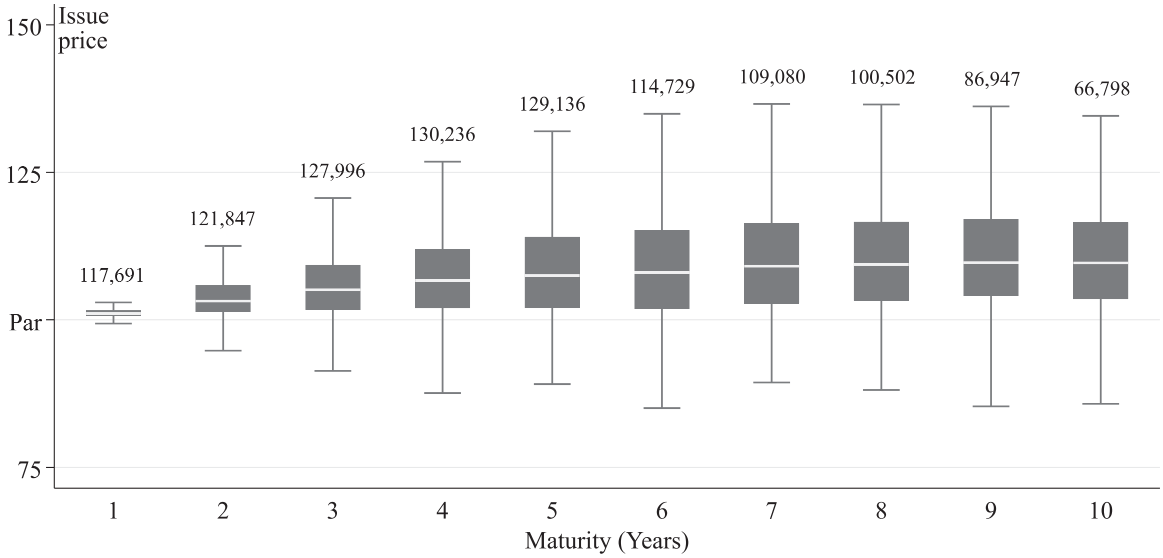

Fig. 5. Distribution of issue premium by maturity class. The box contains the middle 50% of the empirical distribution of issue price. Only outliers are outside the area enclosed by the whiskers. The number of observations used to draw each box is above the upper whisker. Sample: noncallable tax-exempt bonds issued between 2000 and 2015 with maturity up to ten years. Data: Mergent Municipal Bond (see Section 2.1).

Table 3
OLS regression of issue price on years to maturity.
Each observation corresponds to a distinct security. Specification (1) is a pooled OLS regression. Specification (2) is also a pooled OLS regression, but the observations are weighted by the dollar issue amount. Specifications (3) and (4) are like Specifications (1) and (2) with added series fixed effects. A series is a set of bonds issued by the same issuer on the same day for the same purpose. Constant terms are omitted. *t*-statistics are reported in parentheses under the coefficients. Stars indicate significance at the 90% (*), 95% (**), and 99% (***) levels. Sample: noncallable tax-exempt bonds issued between 2000 and 2015 with maturity up to ten years. Source: Mergent Municipal Bond (see Section 2.1).

	Dependent variable: Issue price			
	(1)	(2)	(3)	(4)
Years to maturity	0.344***	1.110***	0.288***	0.809***
	(155.9)	(110.1)	(175.4)	(154.3)
Series fixed effects	No	No	Yes	Yes
Bond insurance control	No	No	Yes	Yes
Value weighted	No	Yes	No	Yes
N. Obs.	1,104,962	1,100,100	1,104,962	1,100,100
Adj. R^2	0.027	0.243	0.664	0.812

As a formal check on the visual evidence of Fig. 5, Table 3 presents the results of a regression of issue price on maturity. Specifications (1) and (2) estimate Eq. (2):

$$Issue\ price_i = \alpha + \beta \cdot Time\ to\ maturity_i + \varepsilon_i, \quad (2)$$

where an *Issue price* of 100 indicates face value, and *Time to maturity* is in years. Specification (1) is equal weighted (i.e., estimated by minimizing the equal-weighted sum of squares), whereas Specification (2) is value weighted like Fig. 5.

Specifications (3) and (4) estimate Eq. (3):

$$Issue\ price_i = \alpha_k + \beta \cdot Time\ to\ maturity_i + \gamma \cdot Insured_i + \varepsilon_i, \quad (3)$$

where *Issue price* and *Time to maturity* are defined as in Eq. (2), and α_k is an intercept specific to each bond series k. This specification is designed to minimize unobserved heterogeneity and obtain a clean measurement of the relation between issue price and maturity. A "series" is a set of bonds issued by the same issuer on the same day for the same purpose. Within a series, bonds vary almost exclusively by maturity and coupon rate. *Insured* is an indicator variable that is one if the bond is insured and zero otherwise; this variable is included to control for the rare cases (less than 2% of all series) in which only some of the bonds in a series are insured, resulting in multiple credit ratings for the same series. The results are robust to excluding series with multiple credit ratings. Specification (3) is equal weighted and Specification (4) is value weighted.

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Table 4
Example of bond taxation under different assumptions about trading (no trade, realize gain, realize loss) and issue price (par, discount, premium).

Bonds are issued at time 0 and mature at time 1; any trading happens at time ε, shortly after issuance. Investors can realize three types of income: capital gain or loss (Cap. gain), interest (Int.), or market discount gain (Mkt. disc.). Interest income is calculated as coupon income, plus OID, minus premium. Interest is taxed at a rate of 40% for taxable bonds and 0% for tax-exempt bonds. Regardless of bond type, capital gains and losses are taxed at a rate of 20% and market discount gains at a rate of 40%.

I. No trade. Issue yield is $y_0 = 6\%$.			% of P_0
Any issue price P_0		Interest income	6.00%
Any coupon		Tax (taxable bond)	2.40%
		Tax (tax-exempt bond)	0.00%

II. Realize gain. At time ε, yield drops to $y_\varepsilon = 4\%$.			Seller	Buyer		Total	
Bond issue price			Cap. gain	Int.	Mkt. disc.	$	% of P_0
Par (Coupon = 6%)		Income:	1.92 +	4.08 +	0.00 =	6.00	6.00%
P_0 (Issue price)	100.00	Tax (taxable):	0.38 +	1.63 +	0.00 =	2.02	2.02%
P_ε	101.92	Tax (tax exempt):	0.38 +	0.00 +	0.00 =	0.38	0.38%
Discount (Coupon = 4%)		Income:	1.89 +	4.00 +	0.00 =	5.89	6.00%
P_0 (Issue price)	98.11	Tax (taxable):	0.38 +	1.60 +	0.00 =	1.98	2.02%
P_ε	100.00	Tax (tax exempt):	0.38 +	0.00 +	0.00 =	0.38	0.38%
Premium (Coupon = 8%)		Income:	1.96 +	4.15 +	0.00 =	6.11	6.00%
P_0 (Issue price)	101.89	Tax (taxable):	0.39 +	1.66 +	0.00 =	2.05	2.02%
P_ε	103.85	Tax (tax exempt):	0.39 +	0.00 +	0.00 =	0.39	0.38%

III. Realize gain. At time ε, yield drops to $y_\varepsilon = 8\%$.			Seller	Buyer		Total	
Bond issue price			Cap. gain	Int.	Mkt. disc.	$	% of P_0
Par (Coupon = 6%)		Income:	−1.85 +	6.00 +	1.85 =	6.00	6.00%
P_0 (Issue price)	100.00	Tax (taxable):	−0.37 +	2.40 +	0.74 =	2.77	2.77%
P_ε	98.15	Tax (tax exempt):	−0.37 +	0.00 +	0.74 =	0.37	0.37%
Discount (Coupon = 4%)		Income:	−1.82 +	5.89 +	1.82 =	5.89	6.00%
P_0 (Issue price)	98.11	Tax (taxable):	−0.36 +	2.35 +	0.73 =	2.72	2.77%
P_ε	96.30	Tax (tax exempt):	−0.36 +	0.00 +	0.73 =	0.36	0.37%
Premium (Coupon = 8%)		Income:	−1.89 +	8.00 +	0.00 =	6.11	6.00%
P_0 (Issue price)	101.89	Tax (taxable):	−0.38 +	3.20 +	0.00 =	2.82	2.77%
P_ε	100.00	Tax (tax exempt):	−0.38 +	0.00 +	0.00 =	−0.38	-0.37%

3. The taxation of bonds

This section describes the tax accounting mechanism that drives the results in this paper. For a bond issued at par, when the market price drops below par, the bonds is said to have a market discount [Internal Revenue Code Section 1278(a)(2)(A)]. When the buyer of a market discount bond later disposes of the bond, or the bond matures, any market discount gains are taxed at the ordinary income rate [Section 1276(a)(1)], regardless of whether the bond is taxable or tax exempt. OID bonds are treated in an economically equivalent way: a market discount exists when the price drops below the original issue price plus accreted OID [Section 1278(a)(2)(B), Section 1278(a)(4)]. A specific treatment for OIP bonds, however, is not contemplated in Section 1278 or anywhere else in the Internal Revenue Code. Therefore, the market discount rules are triggered only when the market price falls below par. Clearly, the price of a bond issued at a premium is less likely to fall below par than the price of a bond issued at par. Stated in terms of yield, par and OID bonds become market discount bonds when the market yield exceeds the original issue yield, whereas OIP bonds become market discount bonds only when the market yield exceeds the coupon. This uneven treatment causes OIP bonds to yield more interest income and less market discount gains. For taxable bonds, the classification of income as interest or market discount gain is unimportant because both types of income are treated as ordinary income. However, for tax-exempt bonds, interest income is tax exempt [Section 103(a)], whereas market discount gain is taxable. Therefore, OIP tax-exempt bonds have an important tax advantage.

Table 4 compares three scenarios to clarify the relevant tax rules. In these scenarios, all investors are assumed to be identical, facing tax rates $\tau = 40\%$ for ordinary income, $\tau_G = 20\%$ for capital gains and losses, and $\tau_E = 0\%$ for tax-exempt income. These rates approximate the marginal tax

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rates of an individual in the top tax bracket under the current US rules.[14]

In all scenarios, a bond is issued at time 0 with an issue yield $y_0 = 6\%$. At time 1, the issuer pays off the principal amount plus a coupon. If the bond's coupon rate is 6%, the bond will be issued at par with an issue price equal to face value (normalized to 100). The issuer can also issue the bond at a discount, with a coupon rate of 4% and a price of 98.11, or at a premium, with a coupon rate of 8% and a price of 101.89. Note that for the issuer, the choice of coupon has no real consequences. An issuer who wishes to borrow $1 million could do so by selling 10,000 par bonds at 100 each, or 10,193 discount bonds at 98.11, or 9,815 premium bonds at 101.89. In each case, the promised repayment (principal plus coupon) at time 1 would be $1,060,000, i.e., the amount borrowed times one plus the yield.

In the first panel of Table 4 (no trade), an investor buys the bond upon issue and holds it to maturity. In the absence of trading, regardless of issue price, the investor receives interest income equal to the interest paid by the issuer. Consistent with current tax rules, interest income is defined as coupon, plus OID, minus premium.[15] Because the yield is 6%, the investor obtains interest income equal to 6% of the issue price. If the bond is taxable, interest income is treated as ordinary income, and the investor has a tax liability equal to 2.40% of the issue price ($6\% \times 40\%$). If the bond is tax exempt, interest income is treated as tax-exempt income, and the investor has no tax liability.

In the remaining two scenarios, the bond is traded once and then held until maturity. The timeline is the same as in Fig. 1: the sale happens at time ε, shortly after issuance. The tax consequences of the sale are measured by the overall change in taxes paid by investors in aggregate over the life of the bond (or, equivalently, the overall change in government tax revenues).

In the second panel of Table 4 (realize gain), the bond's yield drops to 4%, and the seller realizes a taxable capital gain. As in the no trade scenario, the outcome does not depend on the bond's issue price. As a direct result of the seller's capital gain, the buyer establishes a higher tax basis in the bond, causing an equal reduction in interest income at time 1. For a taxable bond, converting interest income into capital gains reduces the total tax paid over the bond's life from 2.40% to 2.02% of the issue price.[16] For a tax-exempt bond, converting interest income into capital gains increases the total tax paid over the bond's life from 0% to 0.38% of the issue price. This is unambiguously good for government revenue and bad for investors in aggregate. The resulting reluctance to sell appreciated tax-exempt bonds is examined in Landoni (2013).

In the third panel of Table 4 (realize loss), the bond's yield rises to 8%, and the seller realizes a taxable capital loss. For simplicity, the loss is assumed to generate an immediate rebate at the capital gains tax rate. As a direct result of the seller's loss, the buyer establishes a lower tax basis in the bond, causing an equal increase in income at time 1. Unlike in the previous scenarios, the tax treatment of this additional income depends on the bond's issue price.

For bonds issued at par or discount, both taxable and tax exempt, the additional income takes the form of a market discount gain and is taxed at ordinary rates. Compared to the no trade scenario, total dollar taxes paid increase from 2.40% to 2.77% of the issue price for taxable bonds, and 0% to 0.37% for tax-exempt bonds. For bonds issued at a premium, however, the additional income takes the form of interest income.

For premium taxable bonds, this disparity of treatment is largely inconsequential. Because interest income is taxed at the same rate as market discount gains, the total tax paid over the life of the bond is unaffected by the issue price.[17]

For premium tax-exempt bonds, however, market discount gains are taxable, but coupon income is not. Thus, the only tax consequence of realizing the loss is the immediate tax rebate, and total taxes paid over the life of the bond are negative. Moreover, as shown in the realize gain scenario, this favorable tax treatment of losses is not offset by an unfavorable treatment of gains. Thus, the tax code contains an implicit subsidy for premium tax-exempt bonds.

For this subsidy to be fully realized, bonds should be issued with a price high enough that it never falls below par. If the bond is issued at a premium and later sold at a discount, the outcome for investors will be a mix of the premium and discount cases in the realize loss scenario; any discount will still be treated as a market discount.

4. A dynamic model of issuance and trading

In this section, the tax accounting distortions of Section 3 are shown to play a major role in determining the optimal issue price, even in a dynamic setting where

[14] I explicitly keep track of tax-exempt income, even though the tax rate is 0%, because other important classes of investors face positive tax rates on tax-exempt income. For instance, nonlife insurers face top marginal tax rates of $\tau = 35\%$, $\tau_G = 35\%$, and $\tau_E = 5.25\%$ (Burstein, 2007). Applying these tax rates to the examples in this section makes it evident that these investors, too, should demand premium bonds.

[15] Because this example deals with a one-year bond, OID and premium are included in taxable income at time 1. For multi-year bonds, OID is included in interest income using the constant yield method (Internal Revenue Code Section 1272 for taxable bonds and Section 1288 for tax-exempt bonds). Premium (whether original issue premium or not) is also amortized using the constant yield method [Section 171(b)(1)]. Amortization is optional for taxable bonds, but it dominates the alternative (Constantinides and Ingersoll, 1984). Amortized premium offsets interest income, regardless of whether interest income is taxable or tax exempt [Treasury Regulations Section 1.171-2(c)].

[16] Realizing a capital gain creates an immediate tax cost, whereas the corresponding benefit (lower interest income) is only realized in the future. Thus, the present value of total taxes paid can increase or decrease, depending on the bond's maturity and the level of interest rates. In this one-year example, however, discounting is essentially a nuisance, and throughout this section I simply focus on undiscounted values.

[17] In fact, for taxable bonds with maturities longer than one year, issue premium is slightly less efficient than par or discount: market discount gains are realized and taxed only upon sale or maturity, whereas coupon income is realized every year throughout the bond's life. Therefore, the total dollar amount of tax is the same but it is paid sooner.

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other tax arbitrage strategies are available. An estimate of the subsidy's total yearly cost to the US Treasury is derived by combining model-calibrated values with data on actual issuance.

The examples in Section 3 seem to suggest that it is efficient to increase the issue price without bound, as a higher issue price means a lower probability of market discount. A bound arises naturally in a dynamic setting, as the issuer faces an incentive to keep the issue price as low as possible. This incentive is a consequence of the option-like payoff from tax timing strategies. If realizing gains or losses has favorable tax consequences, the investor will trade and obtain a positive payoff. Otherwise, the investor will refrain from trading and obtain a payoff of zero. As in the case of actual option contracts, the value of tax timing options is magnified by the price volatility of the underlying asset. Thus, other things being equal, competitive investors are willing to pay more for bonds with a more volatile price. This factor alone would cause issuers to prefer zero-coupon bonds, because bonds with lower coupon rates have more volatile prices. Combined with the accounting incentive to issue premium bonds, this factor determines a finite optimal issue price.

4.1. Model description

The pricing model, described in Section 1 of the online Internet Appendix, is similar to Constantinides and Ingersoll (1984), henceforth "CI". The marginal investor is an individual who is indifferent between buying a default-free coupon bond or investing in a one-period bond at any point in time. The return on the one-period bond (the short rate) follows a random walk without drift constrained between the values of 0% and 10%. The investor is subject to a realistic approximation of the US federal income tax code, ignoring state taxes.[18] Whereas CI focus only on bonds issued at par, I take a step further and allow the issuer to choose the issue price by setting the coupon rate.[19]

4.2. Selected model results

Fig. 6(a) graphs the likelihood of market discount as a function of coupon rate for bonds of different maturities (2 years, 5 years, 10 years, and 20 years). The likelihood of market discount is defined as the expected percent of a bond's lifetime spent as a market discount bond. The graph is drawn assuming a starting value for the interest rate process $r_0 = 5\%$. Five percent is chosen because it is the midpoint of the range of interest rates under the assumed process, but the results are qualitatively unchanged for different values of r_0.[20]

For OID bonds (to the left of par), the issue price does not affect the likelihood of market discount. For an OID bond to become a market discount bond, the yield must rise above the original issue yield, an event that can happen regardless of the issue price. However, for an OIP bond (to the right of par) to become a market discount bond, the price has to drop below par. Thus, a higher issue price immediately implies a lower likelihood of market discount. The marginal benefit of raising the issue price depends on the bond's maturity. To reduce the likelihood of a market discount below a given threshold, longer-term bonds require a higher issue price. This produces an upward-sloping term structure of issue prices, as shown in Fig. 6(b).

4.3. Value of optimal issuance

The model-implied gain from issuing optimally is substantial. For instance, the difference in the capitalized tax arbitrage value between a ten-year, tax-exempt bond with the optimal amount of premium and a par bond is between 0.71% and 1.31% of issue proceeds. To put these numbers in context, Joffe (2015) estimates the value-weighted average cost of issuance at 1.02% of face value. Thus, the subsidy for premium bonds is of the same order of magnitude as the cost of issuing.

Optimally issued bonds can be compared to bonds issued at real-world prices. Although the issue premiums of real-world bonds are typically lower than the optimum indicated by the model, issuers appear to capture a large fraction of the theoretical maximum subsidy. For instance, in the current low interest rate environment, the optimal issue premium for a five-year bond is 16.54 (i.e., a price of 116.54). The average premium for five-year bonds issued in the most recent five years (2011–2015) was 12.52, enough to reach 97.5% of the theoretical maximum subsidy. For a ten-year bond, the optimal level of premium is 36.66, but the actual average of 15.30 was enough to reach 83.5% of the theoretical maximum subsidy. Using all bond issues in the Mergent sample, the average annual subsidy for 2011–2015 was $1.7 billion or 0.5% of the average issuance volume of $355 billion.[21] This value is the expected present value cost to the US Treasury. The realized cost depends on the actual tax arbitrage opportunities created by the future path of bond prices.

Throughout the paper I have assumed that issuers capture all of the present value of the future tax arbitrage

[18] Ignoring state taxes causes the model to underestimate issuers' incentive to issue premium bonds, because in most cases state taxes magnify the effect of federal taxes. More detail is provided in the online Internet Appendix, Section 2.

[19] Modeling OID bonds requires an expanded model that incorporates the OID tax rules and an additional state variable, the original issue yield. I also introduce a few additional simplifying assumptions. CI explicitly allow for different tax rates for short-term and long-term gains and losses, as well as four scenarios with different assumptions on the deductibility of losses. I assume that all losses are long term and focus on their Scenario I in which losses generate an instant rebate at the capital gains tax rate. These additional simplifying assumptions are conservative, leading to a likely underestimate of the magnitude of the incentive to issue premium bonds.

[20] Intuition suggests that par bonds should trade at a market discount exactly 50% of the time in expectation. The same intuition applies to OID bonds, whose tax treatment is economically equivalent. In practice, however, the model interest rate process can only assume a finite number of discrete values; therefore, there is a substantial probability that the interest rate will stay exactly the same in the year after issuance. When this happens, the bond takes on a very small market discount, pushing the likelihood of market discount to above 50%.

[21] Unlike elsewhere, these calculations include both callable and noncallable bonds of all maturities.

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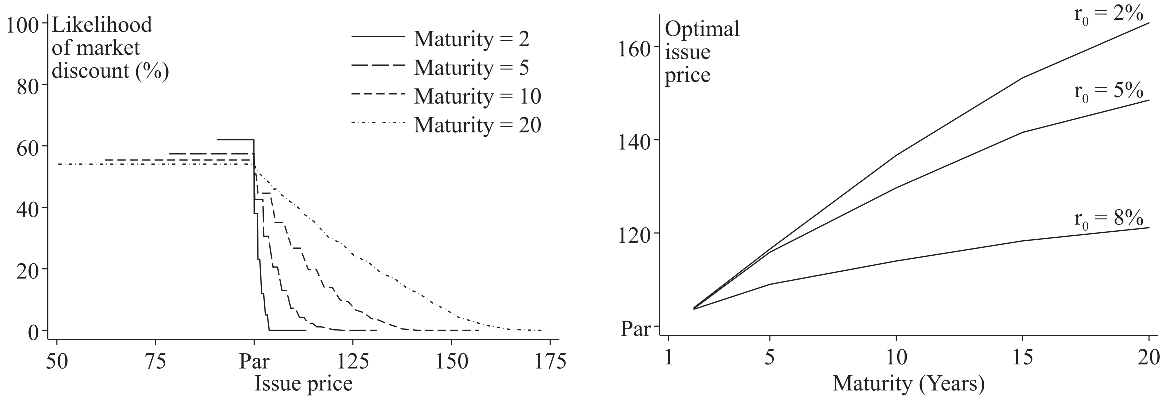

(a) Likelihood of market discount (b) Optimal issue price

Fig. 6. Model output. (a) (left) plots the likelihood of market discount as a function of issue price for bonds of different maturities (2 years, 5 years, 10 years, and 20 years). The likelihood of market discount is defined as the expected percent of a bond's lifetime spent as a market discount bond. The graph is drawn assuming a starting value for the interest rate process $r_0 = 5\%$. (b) (right) plots the optimal issue price as a function of bond maturity for selected values of r_0. The marginal issue buyer is assumed to be a taxable individual. Transaction costs are assumed to be zero.

they create. If part of the value is lost to transaction costs or captured by investors or intermediaries, the subsidy to issuers is reduced, but the conclusions regarding issuance behavior and cost to Treasury are essentially unchanged. The cost to Treasury is only reduced if investors behave suboptimally and underutilize the available tax arbitrage strategies.

5. Conclusion

In this paper I show that tax arbitrage has important implications for issuers of tax-exempt bonds. US states, cities, and other tax-exempt issuers have an incentive to issue bonds with a price well in excess of face value, known as OIP bonds. Tax law subsidizes OIP tax-exempt bonds: compared to bonds issued at par and discount, OIP bonds provide secondary market investors with more tax-exempt coupon income and fewer taxable market discount gains.

The first part of the paper shows that premium bonds are the norm in the tax-exempt market, while they are rare in the taxable market. The analysis also uncovers other puzzling and previously undocumented facts about the tax-exempt bond market. First, coupon rates fluctuate less than bond yields. Second, among noncallable tax-exempt bonds, longer-term bonds are issued at higher premiums. In 2015, the average ten-year bond was issued at a price of 119 per cent of face value, compared to 102 for the average one-year bond. By contrast, taxable bonds (Treasury, municipal, and corporate) are very rarely issued at a premium. Their coupon rates track the current yields, and therefore their issue prices are always at or near par.

The second part of the paper shows that the subsidy for premium bonds has the potential to explain the empirical facts shown in the first part. These facts are reproduced by a dynamic model of optimal issuance in which issuers design their securities to maximize the value of investors' tax arbitrage opportunities, including the harvesting of gains and losses and the conversion of ordinary income into capital gains. Based on the model, the expected cost to the US Treasury is estimated to be approximately $1.7 billion per year.

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