Par Munis — Sub-Par Performance

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Abstract

It is well recognized that institutional municipal portfolio managers prefer premium bonds to those selling near par. We show that such aversion to par bonds is justified, because they are expected to underperform comparable premium or discount bonds in the near term. The extent of the underperformance depends on the shape of the yield curve, and it is positively correlated with the level of expected interest rate volatility.

The underperformance is due to tax considerations. When a municipal bond is purchased below par, the resulting gain is taxed at maturity, and the price is depressed by the present value of this tax. Due to this tax effect, the interest rate sensitivity of discount munis is amplified. Munis selling near par are also negatively convex; the potential decline due to higher interest rates exceeds the increase due to commensurately lower rates. The underperformance of near-par munis relative to those selling at a high premium or at a deep discount is due to the resulting combination of extended duration and negative convexity.

The changing value of tax liabilities creates a unique challenge in determining interest rate sensitivity and expected return, which conventional analytics fail to recognize. The tax-neutral analytics used in this paper incorporate the value of future tax costs, and provide an accurate method for predicting municipal bond price changes and investment returns.

Measures of interest rate sensitivity

Tax considerations are critical to understanding the yield levels and market movements of tax-exempt municipal bonds.[1] In the absence of tax considerations, there would be no explanation why tax-exempt high-grade municipal bonds yield less than U.S. Treasuries of comparable maturity.

Taxes also impact the price movements of municipal bonds, and this should be accounted for in their durations. Effective duration is the primary measure of interest rate sensitivity of bonds — it is the percentage change in price for a 1% change in interest rates. For optionless bonds, duration is a stable measure. Still, price changes aren't exactly linear relative to interest rate changes, so duration changes modestly with the level of interest rates, and this change is measured by convexity. Optionless taxable bonds exhibit positive convexity. Independent of the level where they happen to be trading, prices increase slightly more than indicated by duration when rates fall, and decline less when rates rise. In contrast, a callable bond trading

[1] Municipal bonds are issued by state and local governments, and their authorities. The coupon payments of the vast majority of municipal bonds outstanding are exempt from federal taxation. All references to municipal bonds in this paper are to these "tax-exempt" munis.

near its call price is the textbook example of negative convexity — it has limited potential to appreciate in value when rates fall, but can take a big hit if rates rise. So the duration of a callable bond rapidly changes as it approaches the call price (Tuckman and Serrat, 2012)

De minimis tax rule

The appeal of municipal bonds to investors is that they provide higher *after-tax* income than alternative high-grade bond investments like U.S. Treasuries and corporate bonds. The primary recipients of tax-exempt municipal interest are individual investors, whether directly or through comingled funds, which is no surprise as many individual investors are subject to the highest federal income tax rates today.[2]

If individual investors and their advisors consider tax costs when deciding between munis, Treasuries, or corporate bonds, they also need to be cognizant of taxes when choosing which municipal bonds to buy. This is because investment returns of munis aren't necessarily tax-free.

Bonds purchased at par or at a premium do not have taxes owed at maturity, so their yields are good estimates of their annual after-tax investment returns if the bonds are held to maturity. However, if a municipal bond is purchased at a discount (below face value), the resulting gain is taxed at maturity. The applicable tax rate depends on the size of the gain: de minimis (small) gains are taxed at a relatively low capital gains rate of around 20%, and non-de minimis (large) gains are taxed at the higher ordinary income tax rate of about 40%. The de minimis threshold, as a percentage of par value, is 100 minus the product of 0.25 and the number of whole years to maturity.[3] For example, if there are 10 years left to maturity, the de minimis threshold is 97.50 percent of par. The tax treatment of bonds purchased at a discount is referred to in shorthand by the industry as the 'de minimis tax rule' and its negative impact on the prices of discount bonds is called the 'de minimis tax effect'.[4]

Tax-neutral valuation

To make apples-to-apples comparisons among discount, par and premium bonds, investors incorporate the future tax liability into the price of a discount bond — the price is reduced by the present value of the tax (per Ang et al., 2010, the implied tax rate of investors is high), and this can be observed in the market, as we will show below. Due to this so-called de minimis tax effect, municipal bonds behave differently from taxable bonds with respect to interest rate risk. In fact, they exhibit negative convexity near par, even if they are not callable (Kalotay and Davidson, 2020).

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[2] According to the Federal Reserve Flow-of-Funds, of the $4.2T in muni assets held, 72% is directly held by households and commingled funds that are primarily owned by households as of 3Q 2020.

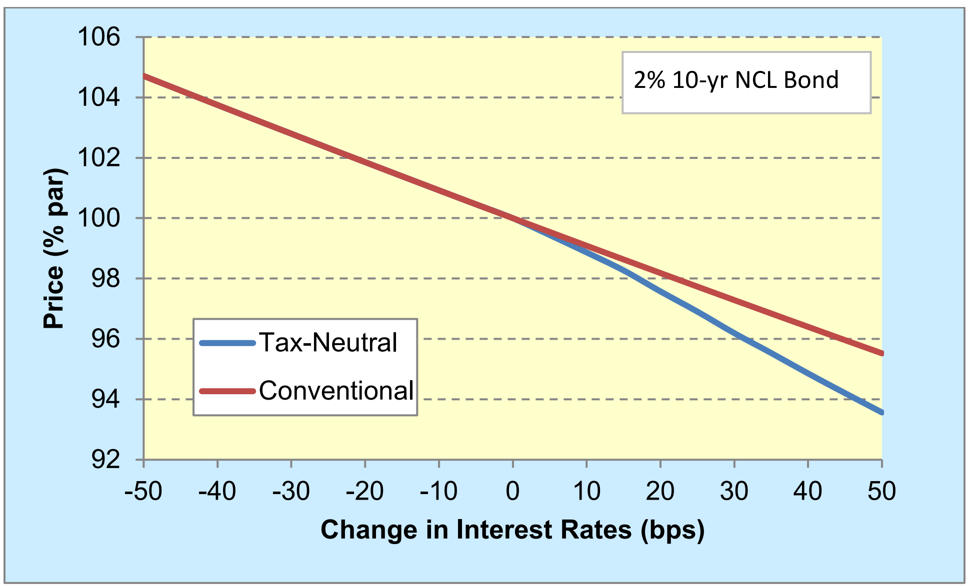
[3] In this paper, we assume the generic bonds discussed were issued at par (their face value) or at a premium. In reality, municipal bonds can be issued at an "original issue discount" (OID).

[4] These terms, used for convenience, are actually misnomers, because the more punitive effect on price occurs when the discount is *non*-de minimis.

Accounting for the future tax liability of discount bonds increases their durations: higher interest rates reduce the present value (PV) of future cash flows; the lower PV increases the tax liability at maturity, which in turn further depresses the PV of the cash flows, and so on. Fortunately, this iterative process converges to the so-called 'tax-neutral' fair value (Kalotay, 2014). A remarkable result of the tax-neutral method pertains to key-rate durations. It was shown in Kalotay and Buursma, 2019, that the key rate durations of a municipal bond priced near par may fail to sum to bond's effective duration.

Figure 1 shows that, due to the de minimis effect, a rise in rates causes the tax-neutral price of a par 2% 10-year municipal bond to fall much further than estimated by conventional analytics. The lower tax-neutral price[5] accounts for *both* the rise in interest rates and the tax liability created for the next buyer. On the flip side, the rally in bond price for a commensurate fall in rates is smaller in magnitude, because there is no tax effect. For example, starting with a price of 100, a 50 bps rise in rates reduces the price by 6.43 points to 93.57, while a like decline in rates increases it by only 4.71 points to 104.71 — the convexity is negative.

Figure 1: Tax-Neutral Valuation Captures Increased Interest Rate Sensitivity Near Par



Tax-neutral prices reflect the impact of the de minimis tax cost. The resulting tax-neutral duration in Figure 2 dramatically captures this impact, and conventional duration misses the mark widely when the price is in or approaching discount territory. Although the correct duration of a 10-year 2% muni selling at a discount is roughly 14 years, conventional analytics indicate it to be only about 9 years, similar to that of a like bond selling at a premium price.

[5] Tax-neutral and conventional calculations performed using Kalotay Analytics' patent-pending MuniOAS software.

Figure 2: De Minimis Effect Extends Effective Duration

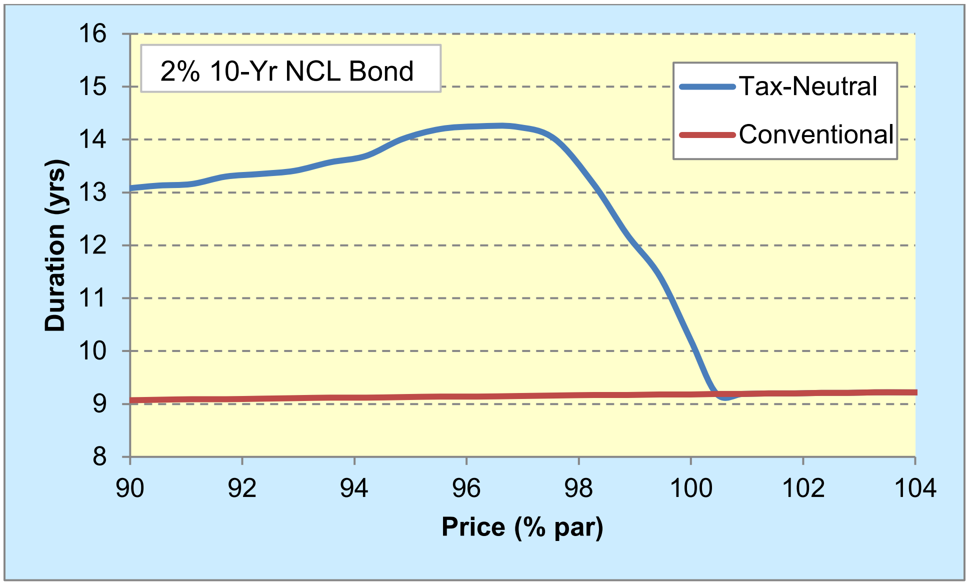
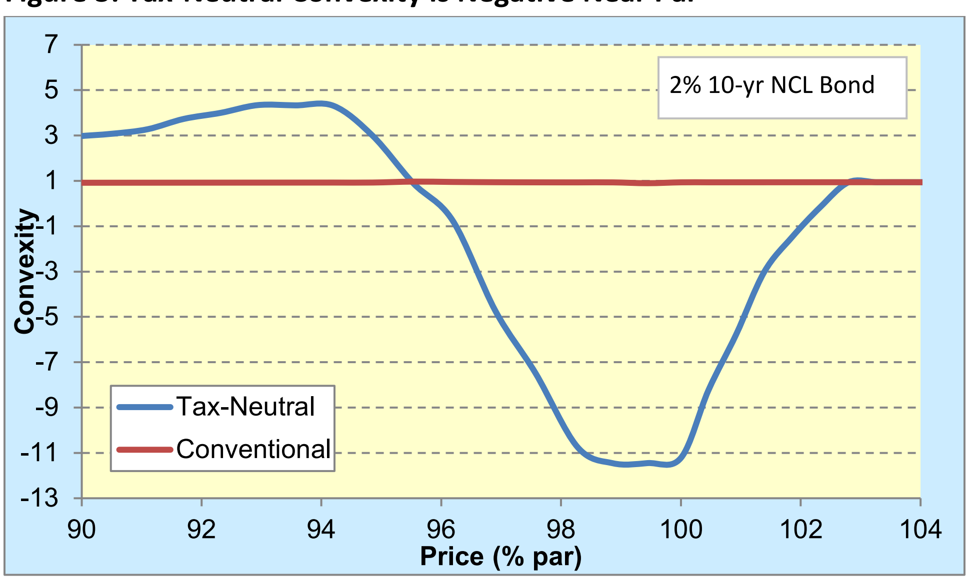


Figure 3 displays the convexity of our 10-year 2% muni near par (calculated by shifting the yield curve 30 basis points). Above a price of 103 the convexity is roughly 1.0, and then it begins to decline, turning negative around 102. As the price approaches par from above, convexity becomes more negative, and it bottoms out at around -12 when the price reaches 99. Below a price of 99, convexity begins to increase, turning positive around 96, and eventually flattening at a level of about 3. If the price is sufficiently far from par, the convexity is positive and nearly constant, similar to what would be expected for any other optionless bond; however, due to the tax effect its level is higher than that of a taxable bond. In short, tax costs play a large role in the price movements of even the most mundane municipal bonds!

Figure 3: Tax-Neutral Convexity is Negative Near Par



When Theory Becomes Reality

Evidence that market participants incorporate taxes when buying discount bonds can be seen each time the yield of a discount bond is higher than that of a comparable premium bond. In August 2016, the Los Angeles Unified School District, a high-grade municipal entity, sold two similar bonds with very different coupons, within its General Obligation Series B issue of that year.[6] The first was a premium coupon bond maturing in July of 2028 with a 5% coupon priced to its July 2026 par call with a yield of 1.68%. The second was a near-par bond (issue price 98) maturing in July 2029 and also callable at par in July 2026, with a 2% coupon to yield 2.18%. As yield spreads to a benchmark 5% non-call 10 yield curve are not apples-to-apples when comparing 5% and non-5% bonds, we use option-adjusted spreads (OAS) to the benchmark-implied triple-A optionless curve for our analysis. At time of issue, the OAS to a national triple-A municipal curve was 10 basis points for the 5's and 16 basis points for the 2's. We selected these two bonds because of their size ($80mm), high-grade ratings, and relatively frequent trading activity in the secondary market over a period when interest rates both rose and fell significantly. Since issuance, the 5's have remained premium bonds, while the 2's have covered the spectrum of discount to par to premium due to the changing levels of interest rates since 2016.

To reduce the noise of large bid/ask spreads for small trades, we assessed only trades where more than $1 million in face value was traded, and on days where more than one trade occurred, we took the trade size-weighted average prices to analyze versus the closing yield curve levels of the day.

In the case of the 5% coupon bonds, since issuance, they have remained priced well above par and their OAS's ranged from -7 to 60 basis points (Figure 4). Movements in both price and OAS for the 2% coupon bonds were far more volatile. The conventional OAS of the 2's rose consistently with lower prices to as much as 150 basis points! As the premium bond did not display this same spread widening, we can infer that the widening with regard to the 2's is not a credit event, but due to the rising future tax liability of the bond as its price falls. In fact, when tax costs are accounted for in the tax-neutral framework, the resulting OAS is more stable and in a range similar to the 5% coupon bond (Figure 5).

[6] Source: MSRB's Electronic Municipal Market Access (EMMA) for issue details and trade prices.

Figure 4: Conventional OAS's of Discount Bonds Overestimated

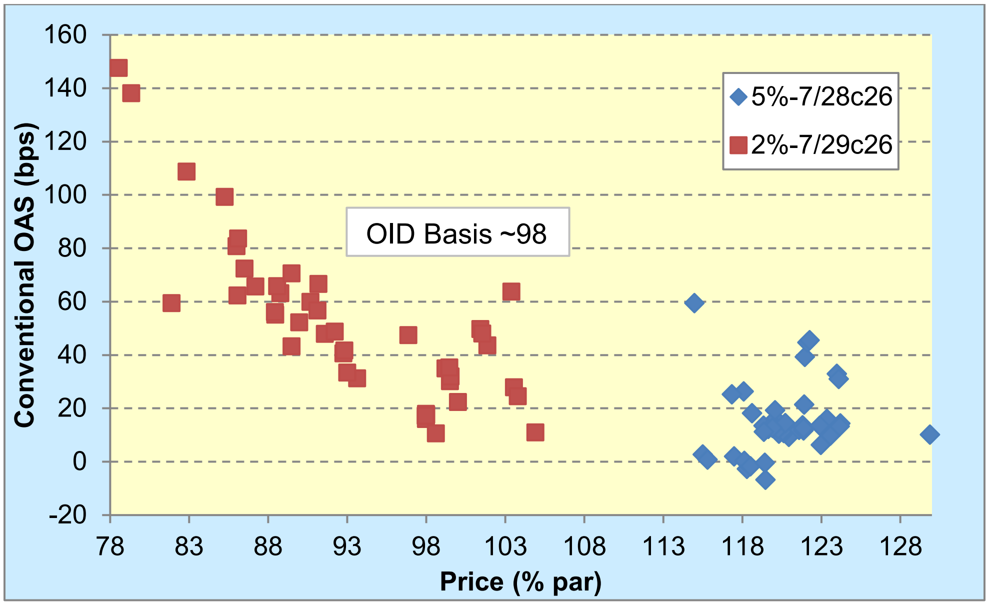
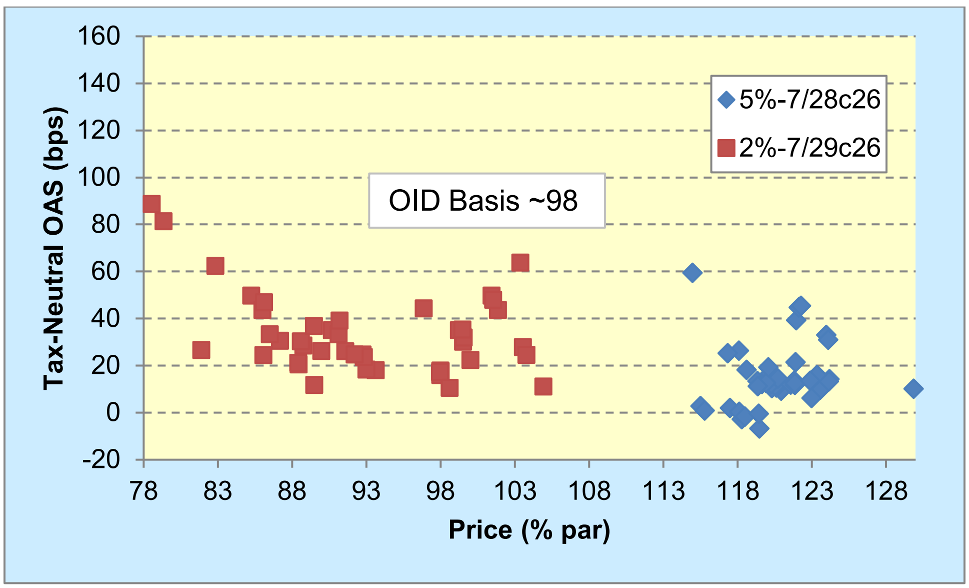


Figure 5: Tax-Neutral OAS of Discounts Consistent With That of Premiums



What are the implications of our findings for municipal bond investors with respect to interest rate risk management? First of all, it is imperative to include tax costs into the price sensitivity of municipal bonds, which conventional analytics fail to do. Consequently, conventional analytics underestimate the duration of municipal bonds when prices fall below par, and they miss the instability of duration changes for bonds priced near par. As shown in Figure 3, conventional analytics completely miss the negative convexity of municipal bonds near par, caused by the de minimis tax!

What is the implication of our findings for investors with respect to portfolio construction? As we will show next, the negative convexity of par municipal bonds can significantly detract from their mark-to-market performance.

Expected Investment Returns

The tax-neutral analytical framework incorporates tax costs *at maturity* due to price appreciation. As we've shown above, for municipal bonds priced near par, these tax costs result in longer durations and negative convexity. In this section, we will quantify the *expected* investment performance over a one-year horizon of munis selling at a high premium, at par, and at a deep discount. We assume that the bonds are optionless, with identical maturities, and fairly priced. As we will see, the par munis are virtually certain to underperform relative to premiums and discounts, and by a large margin.

Our results are derived by Monte Carlo simulation. We assume that the initial yield curve evolves according to the industry-standard Black-Karasinski (log-normal) process, at a user-specified volatility. The expected return of each bond or portfolio is the probability-weighted average of the investment returns from the scenarios in the simulation. We explore the dependence of the results on the shape of the initial yield curve and on the volatility of interest rates. We find that par munis are expected to perform much worse than premiums or discounts, independent of the assumptions regarding the shape of the yield curve and the volatility of interest rates, and the degree of underperformance increases with interest rate volatility. Separately, the relative performance of premiums to discounts does depend on the shape of the yield curve.

The short end of a benchmark municipal yield curve is usually upward-sloping, indicating that yields are more likely to rise than to fall. We observe parenthetically that beyond Year 10 the benchmark curve is defined by the yields to call of 5% non-call 10 bonds, and this implies that the long end of the benchmark curve must rise (Kalotay and Dorigan, 2009, and Kalotay, 2017). An upward-sloping curve is clearly unfavorable to the near-term performance of par bonds relative to premiums and discounts, due to the higher likelihood of the de minimis effect. Before examining the results corresponding to a realistic upward-sloping curve, let's assume that the yield curve is a flat 2%. We consider three optionless 10-year bonds: 5% bonds yielding 2% (priced at 127.07), 2% bonds priced at par, and a 1.5% non-OID bonds yielding 2% after-tax, priced at 93.29, which is well below the 97.50% de minimis level. Note that the effective tax-neutral durations of the three bonds are quite different: the duration of the 5's is 8.3 years, of the 2's 11.3 years, and of the 1.5's it is 14.9 years.

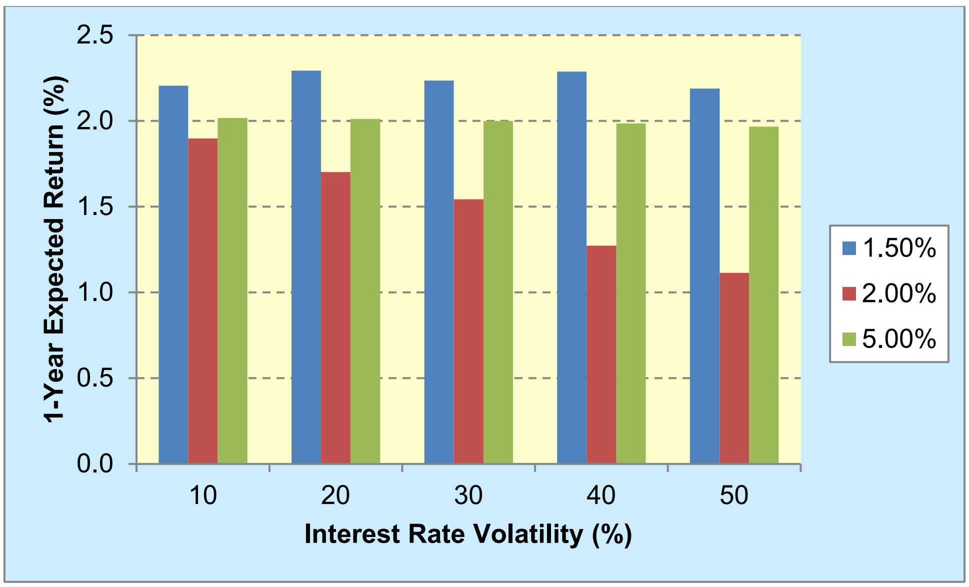
Solo performance

Figure 6 below displays the expected returns for the bonds for a one-year horizon, corresponding to interest rate volatilities ranging from 10% to 50%, under the simplistic assumption of a flat 2% yield curve. Predictably, the return of the 5% premium bonds is roughly 2%, independent of volatility.

The return of the discount 1.5's is slightly higher, roughly 2.15%, and one might wonder why it exceeds 2%. The reason is that under some of the scenarios interest rates decline to a level where the price exceeds the de minimis 97.5% level, in which case the applicable tax rate declines from 40% to 20%, with a commensurate additional increase of the market price.

Turning to the par 2% bonds, it is evident from Figure 6 that they always return less than the 2% target, and the degree of underperformance increases with interest rate volatility: at 10% volatility the return is 1.9%, at 50% volatility it is below 1.2%. The reason is obvious: the higher the volatility, the more likely is the price to decline well below par, where tax considerations further reduce its price.

Figure 6: Par Bonds Underperform (Flat 2% Yield Curve)



As mentioned above, the municipal yield curve is typically upward-sloping. Figure 8 displays the results of our simulation based on a benchmark AAA yield curve (see Figure 7), which is upward-sloping (1-year rate 1.05%, 10-year rate 2.0%). In this case, the 5% premium bonds outperform the 1.5% discounts by roughly 32 bps on average. More significantly, both premium and discount bonds beat the par bonds by a large margin. At a volatility of 30%, appropriate for today's market, the margin is 83 bps and 55 bps, respectively,

Figure 7: Benchmark AAA Muni Curve (to 10 years)

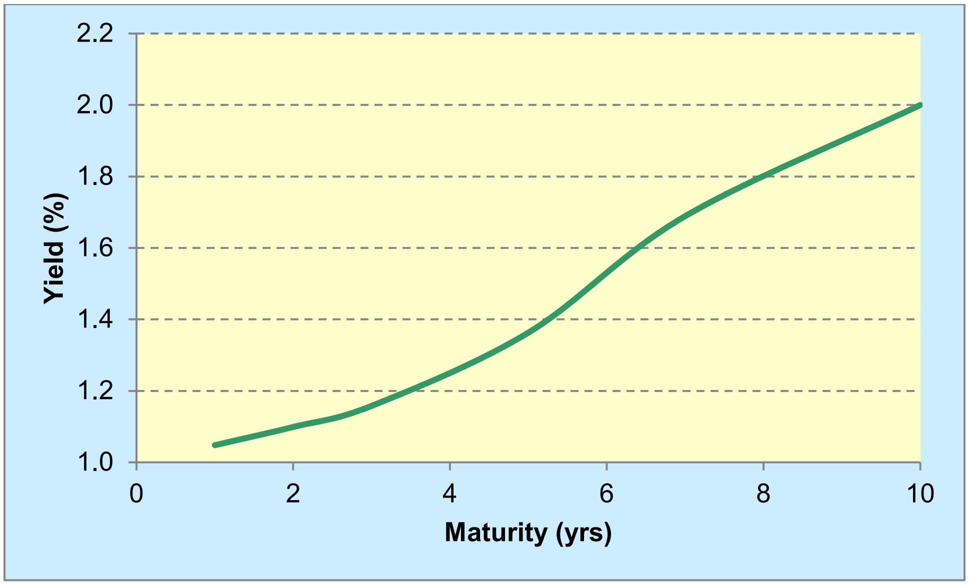
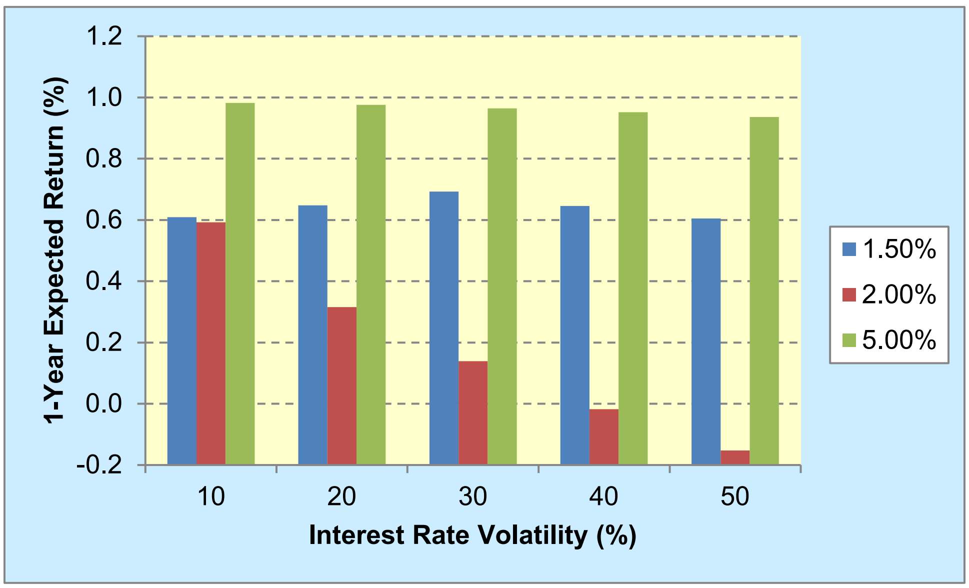


Figure 8: Par Bonds Underperform (Upward-Sloping Yield Curve)



Let us briefly discuss the reason for the underperformance of the par bonds. At a volatility of 30%, the ending 9-year yields ranged from a low of 0.5% to a high of 3.1%, and the corresponding prices for the par bond ranged from 105.6 to 80.2. The fact that the price decline is so much greater than the corresponding rise illustrates the negative convexity we calculated in the first section of this paper. This also explains why the expected return of par bonds is so much lower than that of the premium and discount bonds; the greater price declines reduce the probability-weighted expected return of the par bonds. The reason the discount bonds underperform the premium bonds in an upward-sloping yield curve environment — implying rates will rise on average — is the longer duration of the former (14.9 years versus 8.3 years).

Recap

We have calculated the expected performances of fairly priced 10-year premium, par, and discount bonds over a one-year horizon. Based on their poor solo performance, it is obvious that the par bonds are not suitable for institutional investors, unless their purchase yields are substantially higher than those of comparable premium bonds or deep discount bonds.

On the other hand, par bonds are perfectly acceptable to long-term investors who do not mark their investment portfolios to market, such as banks and insurance companies. If held to maturity, fairly priced par bonds have the same expected performance as that of premium bonds. A possible concern is that, due to some unexpected development, the bonds may have to be liquidated sooner than originally intended.

After-tax performance

In the above section, we calculated investment performance by "marking the portfolio to market" at the end of each period. The intuition is simple: how much money did an investor make over the holding period when considering both investment income and the change in market value of the portfolio holdings. This approach also allows apples-to-apples comparison of competing managerial strategies, independent of the constituents of the portfolios.

Most municipal investors, however, are subject to taxes and care about after-tax investment returns: income plus price changes less tax costs. To this end, whenever there is a liquidation, tax rates are applied to capital gains (and losses) to calculate the after-tax investment return of the portfolio. The SEC standards for calculating after-tax returns of mutual funds were passed in 2001 and are available in fund prospectuses. The Association of Investment Management and Research (AIMR) adopted after-tax reporting standards for separately managed accounts in 1994 (Rogers, 2006). In the following section, we report the after-tax returns of portfolios consistent with AIMR guidelines assuming income is taxed at 40%, capital gains are taxed at 20%, and that the portfolio is liquidated at the end of the investment period.

Figure 9: Tax at Liquidation Improves Poor Pre-Tax Return (Upward-Sloping Yield Curve)

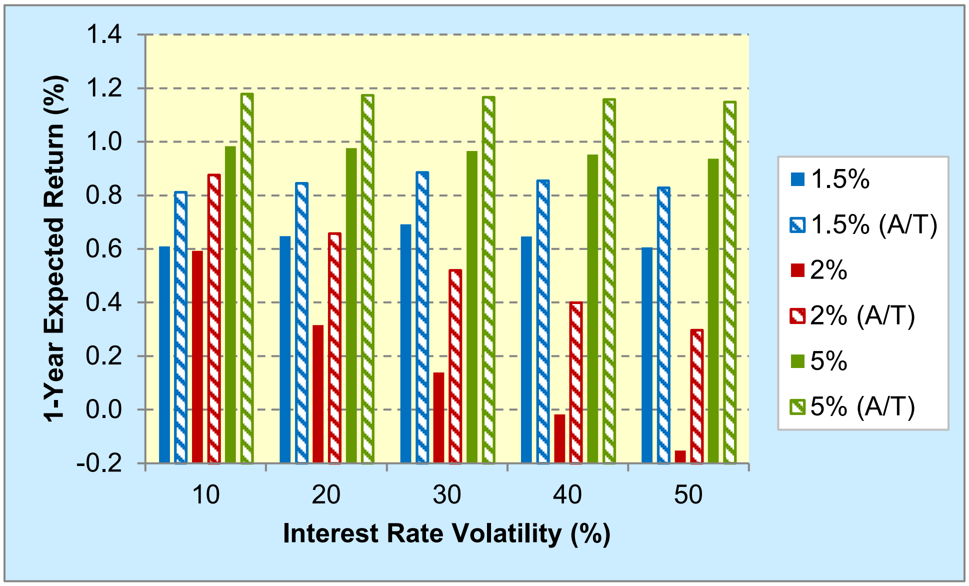


Figure 9 displays the solo pre-tax and after-tax performances assuming an upward-sloping starting yield curve. Due to the rising yield curve, the expected terminal values are low relative to their purchase yields. For example, if the volatility is 30%, the expected terminal value of the 1.5's is 92.37, of the 2's 98.17, and of the 5's 123.78 (basis at horizon: 125.03). The resulting returns are the worst for par bonds but improved by taxes at liquidation, and therefore the after-tax returns exceed the pre-tax returns. At a volatility of 30%, the pre-tax return of the 2's is 0.14%, and the after-tax return is 0.52%.

In general, after-tax performance will exceed poor pre-tax performance, and it will be lower than strong pre-tax performance. On the other hand, it is unlikely to change the ranking of the results. In particular, par bonds are expected to perform poorly, whether measured on a pre-tax or after-tax basis.

Institutional perspective of par bonds

We have shown that on a short-term horizon, e.g. one year, fairly priced par bonds are expected to underperform similar premium or discount bonds, either on a pre-tax or on an after-tax basis. Therefore, fairly priced par bonds are not suitable for institutional investors whose investment performances are ranked and reported based of mark-to-market.

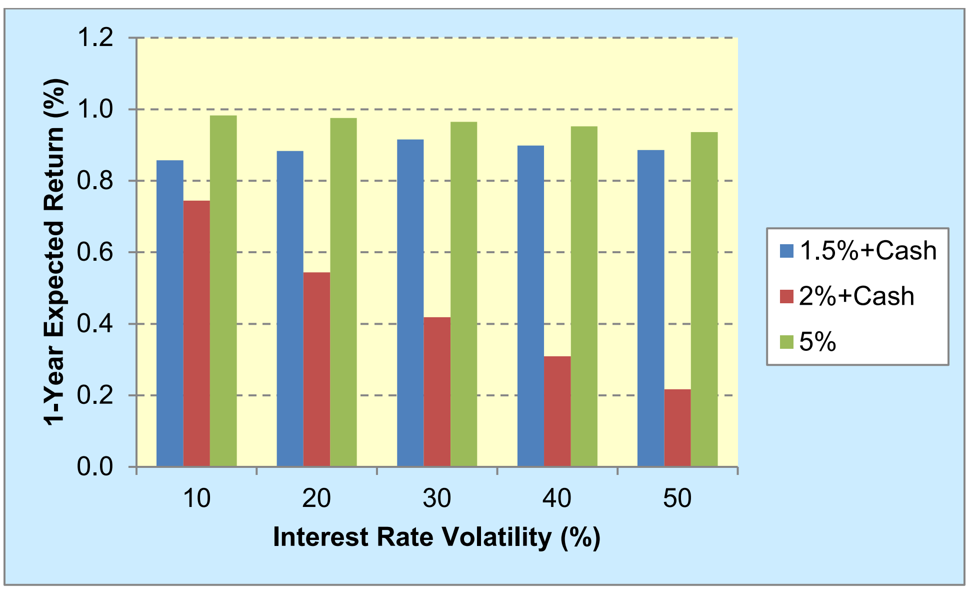
In comparing 'solo' investment performances among discount, par, and premium bonds, we did not correct for their different tax-neutral durations. Below, we add cash (short-term security) in order to create tax-neutral duration-matched portfolios for comparison. This is the framework that professional portfolio managers typically use to assess the relative value of discount, par, and premium bonds.

Duration-matched performance

As we pointed out earlier, the starting tax-neutral durations of the three bonds are quite different: the duration of the par bond is 11.3 years, while the discount and premium bond durations are 14.9 and 8.3 years, respectively. To create portfolios with the starting duration of the premium bond (8.3 years), we add a cash investment to the par and discount bonds; the par bond portfolio is comprised of 74% 2% coupon 10-year bonds and 26% cash, while the composition of the discount bond portfolio is 56% in the discount bond and 44% in cash. Cash is invested in a 12-month security, maturing at the end of the investment period.

The one-year total returns of the three portfolios are shown in Figure 10 below. The results are similar to those in Figure 8 (no cash). The difference is due to the presence of cash, which shifts performance towards the 1-year rate, here around 1%. The portfolio containing the par bonds performs quite poorly in all scenarios relative to the portfolios with the premium and discount bonds. For example, according to Figure 8, at a 30% volatility the expected returns of the 1.5%, 2%, and 5% bonds were 0.69%, 0.14%, and 0.97%, respectively; the corresponding of the duration-matched portfolio returns are 0.92%, 0.42%, and 0.97%.

Figure 10: Cash Tempers Performance But Ranking Unchanged



In an upward-sloping yield curve environment, the inclusion of cash to balance the longer durations of the par and discount bonds reduces the initial portfolio yields. In addition, an upward-sloping yield curve implies higher yields ahead, which impacts the expected value of the par bonds harder because of their negative convexity. A flatter yield curve reduces the cost of negative convexity in our horizon analysis.

Given the poor performance of par bonds, institutional investors (who are marked to market) would presumably consider them only if premium bonds are too rich, and yielding considerably less than comparable par bonds. This has not happened in recent years, as evidenced by institutional investors' avoidance of par bonds in favor of 5% bonds. For a discussion of the appeal of 5% bonds to institutional investors, see Kalotay, 2012.

Conclusion

Due to the de minimis tax effect, the near-term investment performance of par municipal bonds is likely to be significantly worse than that of like maturity premium and discount munis with similar after-tax yields. Investors that are measured and rewarded based on their short- and intermediate-term investment performance have long preferred premium munis over par munis. This in itself is evidence that municipal investors incorporate taxes into both their risk and expected return measures of tax-exempt municipal bonds.

The appeal of munis is that coupon interest is tax-exempt. Consequently, almost all tax-exempt municipal bonds are owned by taxpaying entities, especially individual investors who are subject to high tax rates. However, muni investment returns may not be tax-free. When a municipal bond matures, or is sold, an investor may be subject to taxation. The tax liability depends on the original purchase price and the redemption value. If the principal received at maturity is less than the purchase price, the investor does not have a tax liability; otherwise the difference (or discount) is subject to taxation. If the discount is de minimis (less than the product of 0.25% and the years held to maturity), and the bond was held for more than 12 months as assumed in this paper, the applicable federal tax rate is 20%. If the gain upon maturity is greater, then it is characterized as ordinary income and may be taxed at a higher rate, 40% in this paper.

Investors incorporate tax liabilities when they choose between premium, par and discount municipal bonds. As a result, the price decline of munis is amplified when yields rise and prices fall below par, to account for both the lower present value of the cash flows and for the greater future tax liability a new investor would assume if the bonds were sold. Tax-neutral duration, which accounts for the resulting tax costs, exceeds conventional duration for both par and discount bonds.

Municipal bonds selling near par are also negatively convex because of the quickly changing tax costs — bought at a premium, the tax cost is 0%; at a slight discount, the gain is taxed at 20%, and at a large discount, the gain is taxed at 40%. The rapidly changing interest rate sensitivity of par munis poses a challenge for professional investors in managing interest rate risk. Because the asymmetry of price movements significantly reduces the expected return of par bonds relative to either premium or discount bonds with the similar after-tax yields, total return-oriented institutional investors avoid par munis.

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