Optimal Tax Management of Municipal Bonds

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Abstract

Municipal bonds are held in taxable accounts because of the interest being tax-exempt, but gains and losses are subject to complex tax treatment. We explain how selling at a loss, when the market value falls below the investor's tax basis, can improve after-tax performance. A key input into the calculation of the benefit from sale is the 'hold value' — this can differ substantially from the market price.

The difference between the proceeds from sale and the 'hold value' shows the benefit of selling. If the benefit is positive, the challenge is whether to act now or wait for a possibly better opportunity. The answer lies in the 'tax efficiency' of the transaction. It compares the benefit captured to the value of the 'tax option' (i.e. the right to take a tax loss at any time). The latter's value depends on interest rate volatility and transaction cost. Sale is recommended only if the benefit captures a high percentage of the forfeited tax option, i.e. if the 'tax efficiency' is sufficiently high.

Optimal Tax Management of Municipal Bonds

Tax considerations play an important role in the management of taxable portfolios. In a well-known paper Constantinides and Ingersoll [1984] discuss the applicability of tax management to bonds in general. Tax-exempt municipal bonds are particularly suitable because they are primarily held in taxable accounts. While the interest is tax-exempt, capital gains and losses are subject to complex tax treatment. Empirical research of secondary market trades by Ang et al. [2010] indicates that the marginal investors in tax-exempt bonds are in the highest tax bracket, and recent articles in trade publications confirm this finding (*Bond Buyer*, July 3 and July 8, 2013).

The right to make a tax-driven trade is an option; we will refer to it as the embedded 'tax option' of a bond.[1] Undoubtedly the best-known tax management strategy is selling a bond whose value has declined, i.e. selling a loser (colloquially referred to as tax-loss harvesting). Sequential investors can exercise this option over the life of the bond — when warranted the original holder sells the bond, the new holder acts likewise, and so on. The paper (Kalotay and Howard [2014]) describes an algorithm for optimum tax loss harvesting, and determines the value of the tax option at the time of issuance. The results indicate that the value of the tax-option of a conventional long-term municipal bond is 3% to 6% of the face amount, depending on applicable tax rates, transaction cost, and interest rate volatility. In other words, over the life of the bond

[1] Valuations of the tax option and other calculations in this paper were performed using Kalotay Analytics' MuniOAS™ (patent pending).

active tax managers collectively can generate 3% to 6% of extra value over ‘buy-and-hold’ investors.

The focus of the Kalotay-Howard paper is on the value of tax-loss harvesting over the life of the bond, rather than on optimal sale strategy. In this paper we consider optimum sale strategy from the perspective of the current holder.

In addition to tax-loss harvesting, we also analyze a less familiar tax management strategy, which entails selling winners. This strategy is uniquely applicable to tax-exempt bonds. It can be used by an investor who purchased a bond at a deep discount, and therefore eventually faces a large tax liability on the gain at the income tax rate. Selling the bond and recognizing a portion of the resulting gain at the lower capital gains rate may be a preferable alternative.

We begin the paper with a brief discussion of the tax treatment of municipal bonds. In general, the tax treatment depends on the holder’s purchase date and purchase price. These jointly determine the holder’s basis over time, which, in turn, determines the capital gains or losses resulting from sale.

Next we summarize tax-neutral valuation, which is needed to determine the fair market price and the ‘value of holding’. The value of holding depends on the holder’s basis, and it can significantly differ from the market price, due to the different tax liability of the holder and that of the marginal investor.

The body of the paper explores the optimal tax management strategy. Optimization is a two-step process. First, calculate the benefit from sale by comparing the after-tax proceeds to the value of holding. Second, determine the 'optimum exercise time': sell now or wait for a more favorable opportunity in the future, recognizing that the tax option is continuously exercisable (American-type).

The benefit from sale and the value of the tax option determine the efficiency of transacting, defined as the fraction of the option value that would be realized by selling. 'Tax efficiency' quantifies how close to optimal a sale is, with 100% efficiency being a definite sell signal. Risk-averse investors may transact below 100%. We provide several examples of how savings, option value, and tax efficiency depend on the relevant parameters. The source of the value of the tax option is price volatility; thus, by extension, interest rate volatility increases option value. We also note that transaction cost reduces option value.

In practice, tax-driven sales are usually considered as 'bond swaps': the proceeds of a sale are reinvested in another, possibly similar, bond. In this paper we do not consider the replacement bond explicitly. As long as the replacement bond is fairly priced, its value is equal to the proceeds from sale.

The Tax Treatment of Tax-Exempt Bonds

A thorough discussion of the tax treatment and the after-tax valuation of municipal bonds are given in Kalotay [2014]. We summarize below the relevant tax considerations and the key analytical concepts.

Interest is exempt from federal taxes; however capital gains and losses are taxable. To set the stage, consider the case of a bond held to maturity. If the bond was purchased at a *de minimis* discount[2] the gain is taxed at the capital gains rate at maturity; if the discount was non-*de minimis* the entire gain is taxed as ordinary income. If the bond was purchased at a premium, there is no tax effect.

What if the bond is sold prior to maturity? Gains and losses can be short-term or long-term, depending on the holding period. In the case of a capital loss, we assume that the investor can offset it against gains elsewhere in his portfolio. Currently the applicable long-term capital gains rate, short-term capital gains rate, and income tax rate are approximately 20%, 40% and 40% respectively.[3]

If the bond is purchased at a premium, the tax on sale depends on the holder's basis. The premium is amortized over time and reduces the holder's basis gradually to par as of the maturity date (or the next call date). The difference between the sale price and the holder's basis determines the capital gain or loss.

The tax treatment of a bond purchased at a non-*de minimis* discount is more complicated. The tax on a sale depends on the purchase price, the holder's basis (calculated as above), and the sale price. The difference between the holder's basis and the purchase price is the so-called 'accrued

[2] 0.25 x the number of whole years remaining to maturity at the time of purchase.
[3] The Affordable Care Act of 2010 effectively adds a surcharge of 3.8% to these tax rates. We do not consider it here.

market discount' (AMD).[4] If the gain on sale exceeds the AMD, the AMD portion of it is taxed as ordinary income and the remainder as a capital gain. If the gain is positive but less than the AMD, it is taxed as ordinary income. If the bond is sold below the purchase price, the resulting capital loss is strictly the difference between purchase and sale prices; AMD is ignored.

Original issue discount bonds (OIDs) add another layer of complexity in that accrued original issue discount is not taxable. We will not discuss the specifics here.

The usual transaction under optimal tax management is selling a loser, i.e., a bond whose market value is below the investor's tax basis. However, as we will show, in certain situations selling a winner can also generate value.

Valuation of Tax-exempt Bonds

In this section we describe how to calculate the fair market price of a municipal bond, and its 'hold' value. In the absence of taxes, the industry-standard method is OAS-based valuation (Kalotay, Williams and Fabozzi [1993]). Implementation requires an issuer-specific yield curve and interest rate volatility. If the bond is optionless, this reduces to discounting the cashflows at the appropriate spot rates; volatility is irrelevant. In the absence of an issuer-specific yield curve, the alternative is to use a benchmark yield curve and a bond-specific OAS. On a pre-tax basis the fair price and the unmanaged value to the current holder are identical.

[4] Taxes on the AMD are usually paid when the bond is sold or redeemed (although investors may choose to pay taxes annually).

The OAS approach can be extended to value a tax-exempt bond by considering the marginal investor's and the current holder's after-tax cashflows. Because the cashflows of a bond purchased above par and held to maturity are not affected by taxes, the pre-tax and after-tax values are the same. In contrast, the value of a bond purchased at a discount is depressed by the tax payment associated with the eventual gain. Valuation of callable bonds requires lattice-based implementation, because the timing of the call, and thus that of the tax payment, are uncertain. Note, however, that tax considerations are irrelevant in the municipal issuer's refunding decision.

The after-tax approach described above enables us to estimate the market price of a municipal bond, given a yield curve and a specified interest rate volatility. This infrastructure also allows us to determine the value of the tax option and the optimal time to transact.

Strategies for Tax Management

There are two fundamentally different transactions to manage taxes: 'selling losers' and 'selling winners'. If the holder bought the bond at a premium, the bond is a loser if its price is below the holder's basis. If the bond was bought at a discount, it is a loser if it sells below the purchase price. The obvious motivation for selling losers is to recognize the loss for tax purposes. Because the current short-term capital gains tax rate is around 40%, short-term losses can be particularly valuable.

A winner is the opposite of a loser. The motivation for selling winners is to convert future 'ordinary income' into current long-term capital gain. An investor who purchased a bond at a deep discount and holds it to maturity will be liable to pay tax on the gain at a high (40%)

ordinary income tax rate. However if the current price is above the holder's basis, the gain above the basis would be taxed at a 20% rate. Paying tax currently at 20% on a sufficiently large portion of the gain (and paying 40% on the remainder, representing the accrued market discount) may be preferable to paying tax at 40% on the entire appreciation at maturity.

We define the value of transacting, V(T), as the difference between the after-tax proceeds from sale, V(S) and the 'value of holding' V(H). Both V(S) and V(H) increase as the holder's basis increases. V(S) is the after-tax cash received from sale; V(H) can be determined by OAS-based valuation.[5] The latter requires either an issuer-specific yield curve (as assumed below) or a benchmark curve with a bond-specific OAS. If the bond is optionless the tax payment at maturity is known, and V(H) is simply the present value of the resulting after-tax cashflows.

Examples

Throughout the examples in this paper we assume the yield curve in Exhibit 1 below. In addition, we assume that the interest rate volatility of 20% (needed for option value), the tax rates for ordinary income, short-term capital gain, and long-term capital gain are 40%, 40% and 20% respectively, and that the transaction cost is 0.50% of par.

Exhibit 1: Par Optionless Yield Curve

Maturity (yrs)	0.5	1	2	5	10	20	30
Rate (%)	0.50	1.00	1.50	2.00	3.00	4.00	4.50

[5] V(H) also depends on the holder's tax bracket. However, in the examples below, we assume it is the same as that of the marginal investor, i.e., the highest tax bracket.

Illustration: Effect of Tax Basis

Two years ago the investor purchased a 2.50% bond. The bond has 10 years remaining to maturity. Based on the assumed yield curve, the tax-neutral value of the bond is 93.73, which is well below the 97.50 *de minimis* threshold. At a 0.5% transaction cost the sale price is 93.23. Because the bond was purchased more than one year ago the applicable tax rate is the 20% long-term capital gains rate.

Exhibit 2: Benefit from Selling Losers
(2.50% bond, 10 years to maturity, purchased two years ago at prices shown)

Purchase price	96.00	100.00	111.85
Holder's basis	96.00*	100.00	110.00
Proceeds from sale	93.23	93.23	93.23
Tax savings (immediate)	0.55	1.35	3.35
V(S)	93.78	94.58	96.58
V(H)	94.40	95.57	95.57
V(T)	-0.62	-0.99	1.01

All values in percent of par.
**For a bond purchased at a discount and sold below the purchase price, the basis is the purchase price.*

Let us take a closer look at Exhibit 2. Recall that the basis of a bond purchased at a premium (here for 111.85) amortizes to par at maturity. Hence V(H) (here 95.57) is independent of the above-par purchase price, but V(S) is not. If the bond is purchased at a discount, for 96.00, the tax on the 4 point gain is payable at maturity at a 40% tax rate, and the present value of the taxes is 1.17 (95.57-94.40).

When selling a loser, which is the case here, the savings increase with the holder's basis. Although not shown, V(T) obviously diminishes at a higher transaction cost (lower sale price). If instead of 93.23 the sale price was only 92.23, the proceeds from sale would decline by 0.80 points, but the V(H) would be unaffected.

Exhibit 3: Benefit from Selling Winners
(4% bond, 10 years to maturity, purchased two years ago at prices shown)

Purchase price	60.00	70.00	80.00
Holder's basis	63.94	73.27	82.38
Proceeds from sale*	108.35	108.35	108.35
Tax savings** (immediate)	-10.46	-8.33	-6.15
V(S)	97.89	100.02	102.21
V(H)	97.10	100.04	102.98
V(T)	0.79	-0.02	-0.77

All values in percent of par.
** The tax-neutral value is 108.85 (sale price assumes 0.5% transaction cost).*
***The gain up to holder's basis is taxed at the income tax rate. The remainder is taxed as a capital gain.*

Exhibit 3 above illustrates the benefit of selling a winner which was purchased at a deep discount. Here the motivation is to convert tax on 'income' payable 10 years hence into tax on long term capital gain payable now. In this case the lower the purchase price the larger is V(T).

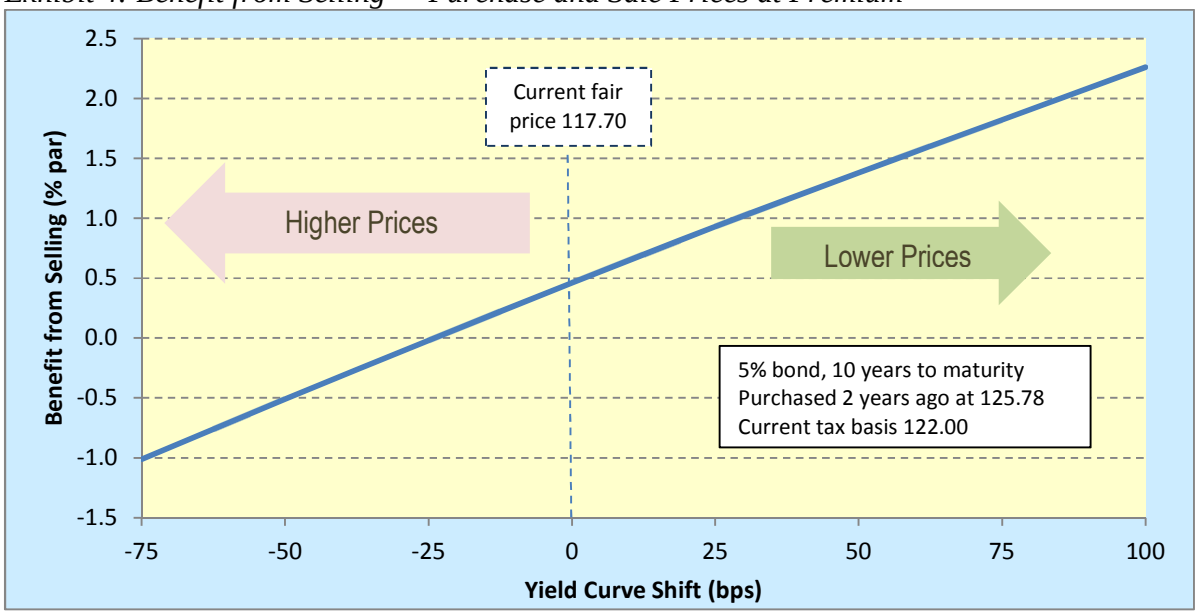
The Effect of Interest Rates on the Benefit of Transacting

In the preceding section we illustrated how to determine the value of transacting V(T). If V(T) is positive, we need to decide whether to transact now or wait for a possibly a more attractive opportunity.

Would higher or lower rates create a more attractive opportunity? The answer depends on the specific situation. Consider, for example, a bond purchased at a premium and currently selling at a premium. Higher rates depress the market price and the value of holding by roughly the same amount, but the lower market price results in greater tax savings. Thus higher rates would increase the resulting benefit. On the other hand, once the market price falls below par, higher rates would disproportionally depress the sale price, and therefore the benefit declines as interest rates keep on rising (not shown in Exhibit 4).

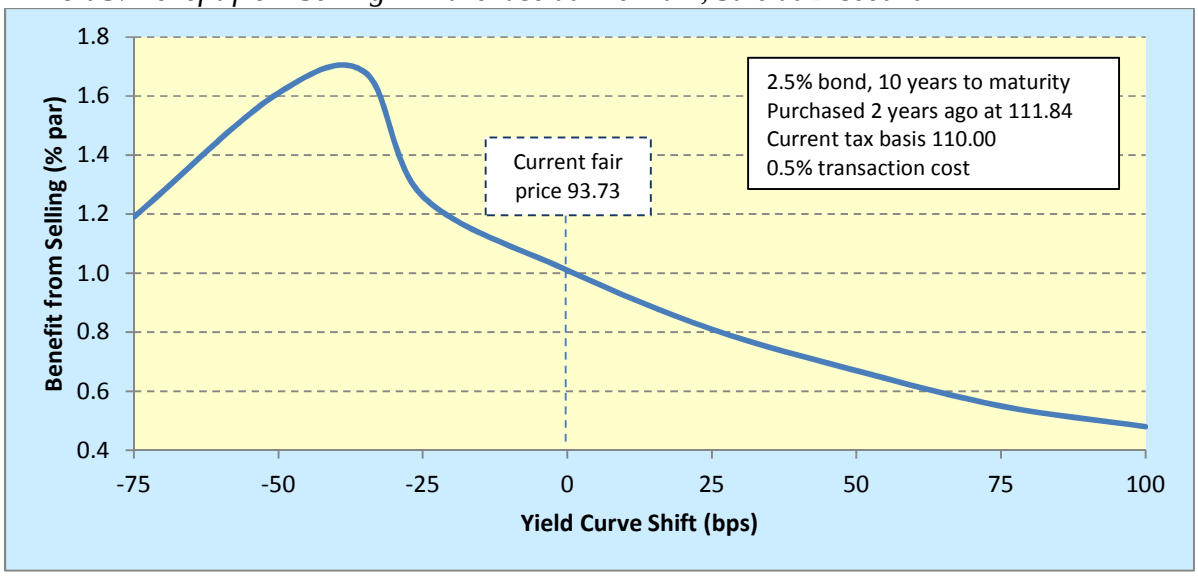
In Exhibit 4 below we consider a 5% bond with 10 years left to maturity. It was purchased two years ago at the price of 125.78, and therefore its current tax basis is 122. Selling is profitable only at a price is well below the 122 holder's basis. The higher the rates, the greater is the benefit.

Exhibit 4: Benefit from Selling — Purchase and Sale Prices at Premium



Next, we consider the effect of interest rates on the 2.50% bond examined in the previous section. Assume that it was purchased over a year ago at a premium, and its current tax basis 110. The current 93.23 sale price is well below the 97.50 *de minimis* threshold.

Exhibit 5: Benefit from Selling — Purchase at Premium, Sale at Discount



According to Exhibit 5, V(T) steadily declines as rates rise and the market price declines. On the other hand, as rates decline V(T) initially increases, and eventually reaches the maximum of 1.68 points when rates decline 35 basis points. The maximum occurs at this point because the 10-year rate corresponding to a -35 bps shift is 2.65%, and this would raise the bond's price above the 97.50% *de minimis* threshold. At a -50 bps shift the price is roughly par, and as rates decline further the V(T) continues to decline.

The above example illustrates the complexity of managing the tax option. If the bond was purchased at a premium and its current price is above par, higher rates increase the benefit from sale; this can be seen in Exhibit 4. However prices below par are depressed by the tax on the gain, without any offsetting benefit to the seller. Consequently, as shown in Figure 2, the benefit from sale below the *de minimis* threshold tends to be marginal — the possible exception being a short-term capital loss.

Algorithm for valuing the tax option

As we saw in the previous section, V(T) depends on the level of interest rates. Selling the bond is a de facto option exercise; the challenge is to determine the optimum time. This problem is similar to that of determining the optimum time to refund a bond; the solution depends, among other factors, on the volatility of interest rates and on transaction costs. The key concept is the efficiency of an option exercise, discussed below.

Valuing the tax option requires assumptions about the evolution of the yield curve and the relationship between yield curves and bond prices. As described in *The Tax Option in Municipal Bonds* (Kalotay and Howard, 2014), tax-neutral values provide reasonable estimates of the actual market prices (Ang et al., 2010, and *Bond Buyer,* July 3 and July 8, 2013).

Subject to the above assumptions, the tax option can be valued as follows:

1. Starting with the current yield curve, generate an interest rate lattice according to a specified stochastic process, such as Black-Karansinski (see Kalotay, Williams, and Fabozzi [1993])
2. Determine the market price (tax-neutral value) of the bond at each node
3. Calculate the investor's tax basis over time, given the purchase date and purchase price
4. Calculate V(S)-VH) at each node (as illustrated in Tables 2 and 3 above)
5. Recursively determine the optimum times to transact (the stopping points) and the resulting benefit

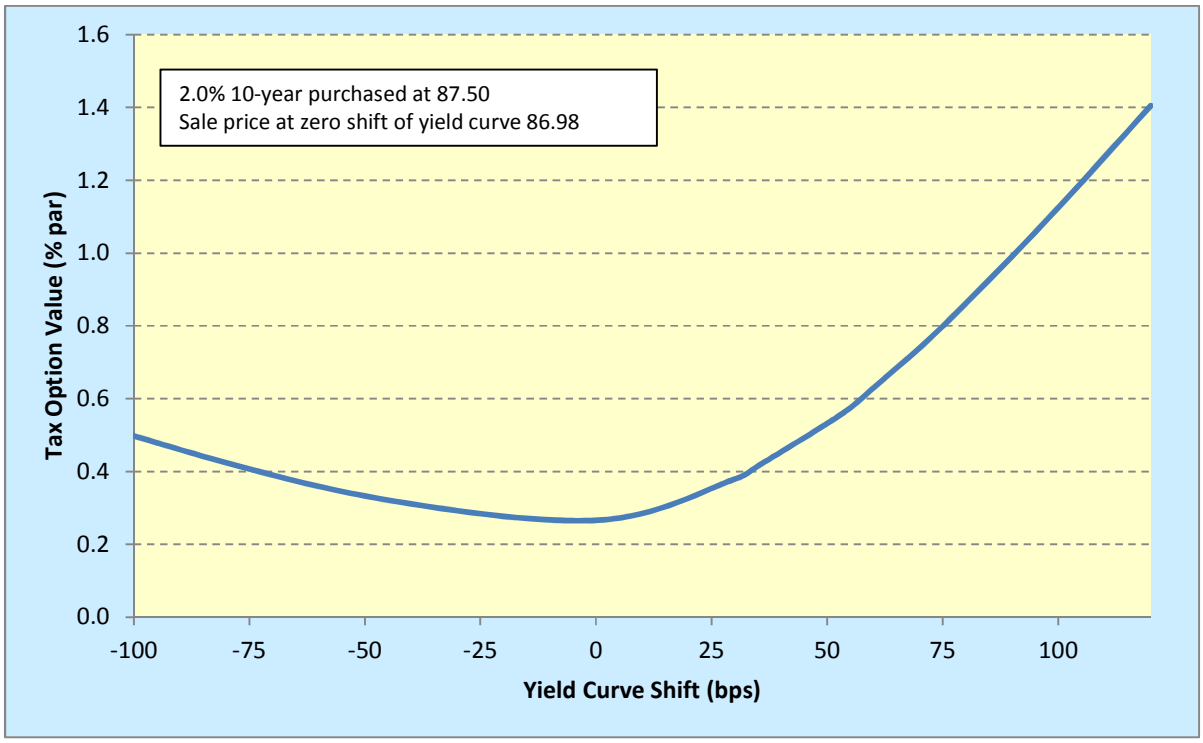
6. The value of the tax option V(O) is the weighted present value of the gains from optimal transactions

Discussion

Exhibit 6 below illustrates the intricacy of tax option behavior. Suppose an investor purchases a 2% bond with 10 years left to maturity for the price of 87.50, and therefore faces a tax liability of 5 points (0.4 x 12.50) 10 years from now.

If rates rise soon after purchase, it may be economical to recognize the resulting price decline as a short-term capital loss, at a 40% rate. But this idea is does not work beyond the first year. On the other hand, if rates decline and the market price increases significantly, it may be economical to sell a winner and convert a gain taxable at 40% into one partially taxable at 20%. However, selling a winner must be postponed for at least one year after the purchase date, so that the gain would be treated as long-term. Thus the tax option is a straddle: its value increases whether rates move higher or lower, but for very different reasons.

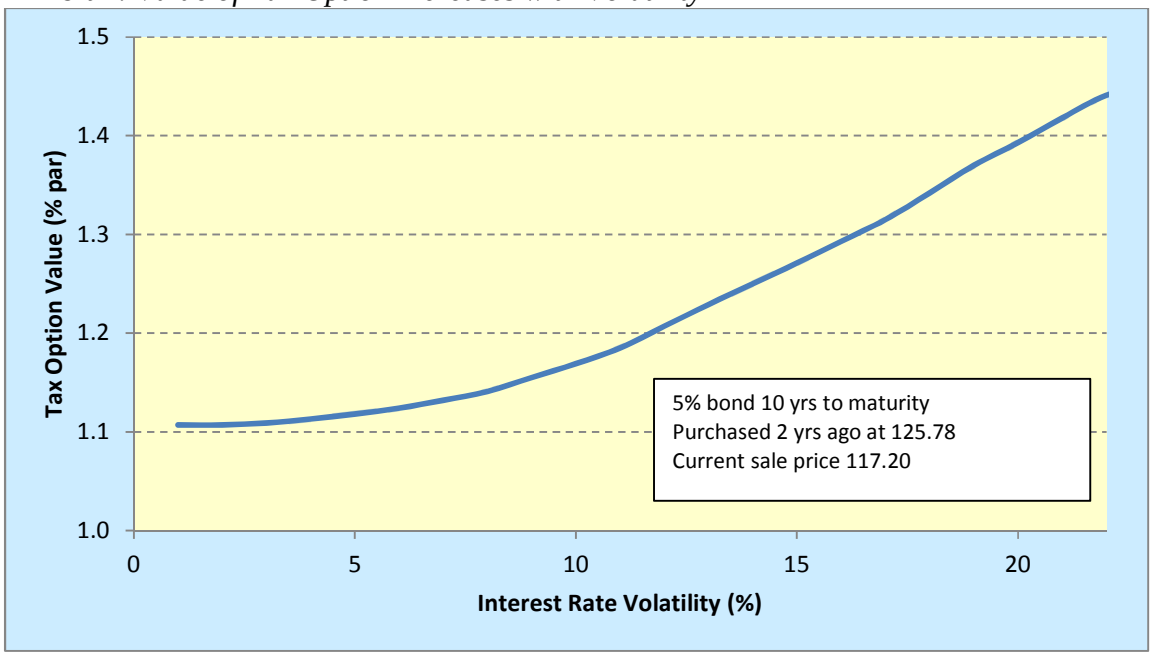
Exhibit 6: Tax Option Can Provide Straddle



In summary, tax management opportunities may arise whether rates increase or decline. But there are several moving parts, and it requires a well-designed computer program to determine the value of the tax option.

Finally, Exhibit 7 shows that the value of the tax option steadily increases with interest rate volatility. The assumed volatility should be realistic; at the present for a log-normal model 10% to 25% would be a reasonable range. If the bond is callable, the tax option and the call option should be valued under the same assumptions.

Exhibit 7: Value of Tax Option Increases with Volatility



Optimum Option Exercise and Tax Efficiency

The benefit from transacting V(T) is V(S)-V(H), where V(S) is the after-tax proceeds from sale and V(H) is the value of holding. Sale forfeits the tax option V(O) in exchange for V(T). In this section we explore what the right time is to exercise the tax option.

V(T) cannot exceed V(O), because V(T) is the exercise value of the option. But V(T) can equal V(O), and in that case the odds favor selling. Although more favorable conditions could arise in the future, the decision is dictated by considering the time value of money, because 'the clock is running'.

If V(T) is less than V(O), the transaction would leave money on the table. Nevertheless a risk-averse investor/manager may prefer the bird in the hand, and elect to transact. The question is how much of the option value should be captured to deem the transaction economically sensible.

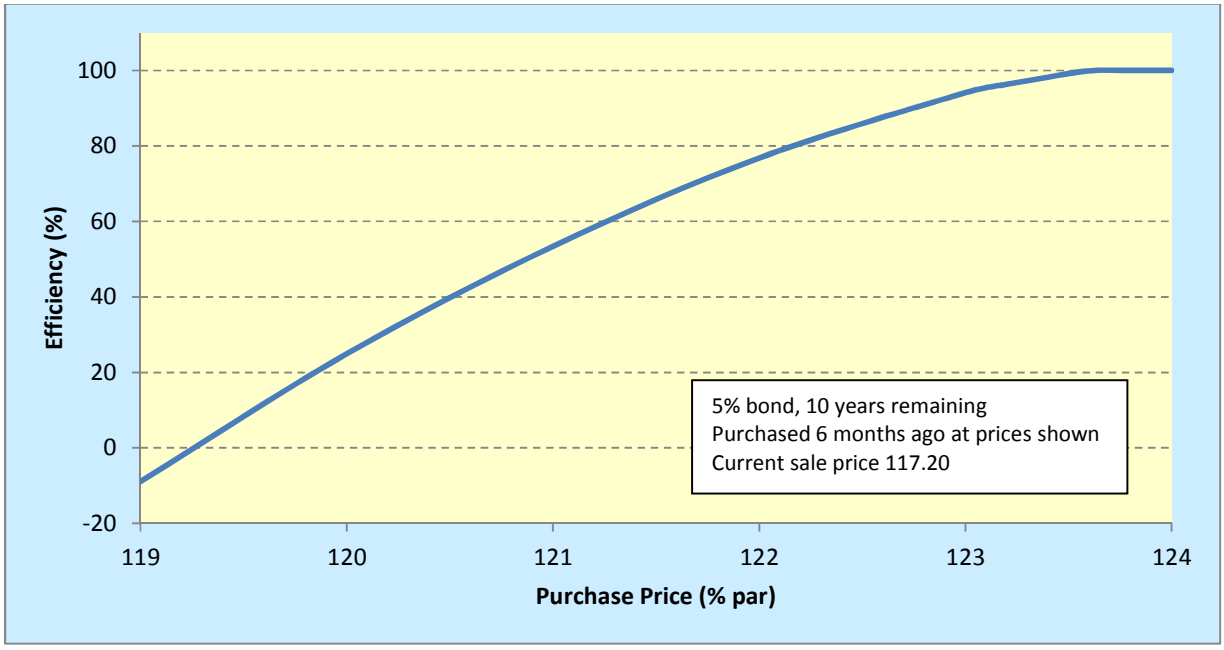
The recommended yardstick is the tax-efficiency measure[6], defined as:

$$Tax\ Efficiency = \frac{V(T)}{V(O)}$$

Deciding on the right level efficiency is a matter of risk aversion; our recommended threshold is 90%. In other words, sell for tax reasons only if the resulting benefit V(T) exceeds 90% of the option value V(O).

Exhibits 8 and 9 below demonstrate how capital losses affect tax efficiency.

Exhibit 8: Efficiency When Selling at Short-Term Loss

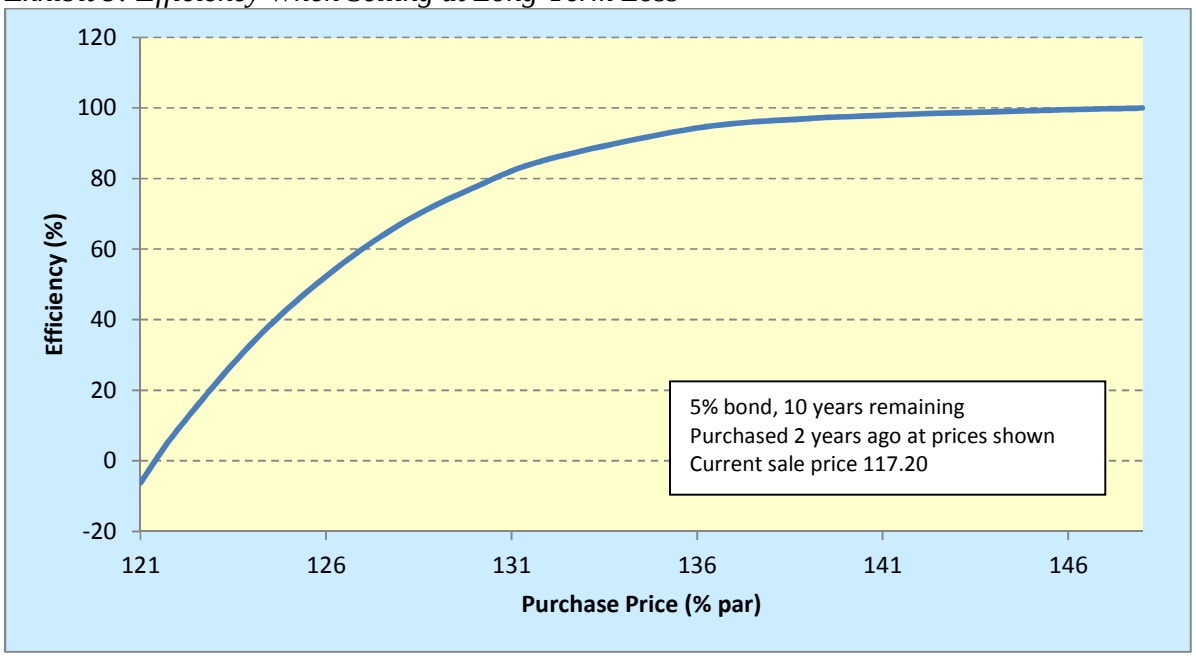


[6] The concept of tax efficiency is analogous to refunding efficiency. See Kalotay, Yang, and Fabozzi [2007].

Comparison of Exhibits 8 and 9 reveals the benefit of being able to take short-term capital losses. The assumption is that a 5% bond with 10 years left to maturity can be sold for 117.20. In Exhibit 8 sale is contemplated 6 months after purchase, while in Figure 6 the sale is two years after purchase. The assumed interest rate volatility in is 20%, and the transaction cost is 0.5%.

According to Exhibit 8, the break-even purchase price is roughly 119.25, and 100% efficiency is reached at a purchase price 123.80. In other words, an investor who recently purchased the bond at 123.80 or more should sell, rather than hold.

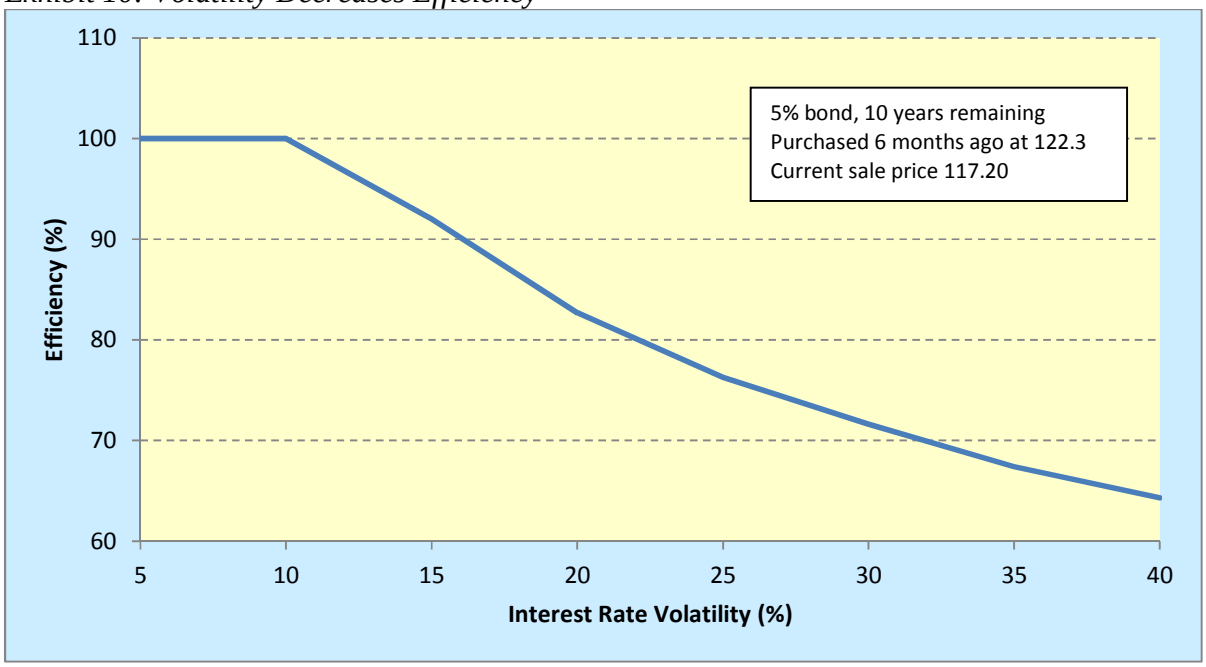
Exhibit 9: Efficiency When Selling at Long-Term Loss



According to Exhibit 9, taking a long-term capital loss is much less lucrative. Here the break-even purchase price is 121.40 (the holder's corresponding basis is 118.32), and in order to reach 100% efficiency the purchase price would have had to exceed 147.90 (basis 140.23).

Finally, Exhibit 10 below demonstrates how interest rate volatility affects efficiency. The assumptions are the same as in Figure 5; the assumed purchase price 6 months earlier is 122.30. If the volatility less than 10%, the efficiency is 100%, signally that immediate action is warranted. As the volatility increases above 10% the efficiency steadily declines: at 20% volatility the efficiency is slightly above 80%, and at 40% volatility the efficiency is roughly 65%.

Exhibit 10: Volatility Decreases Efficiency



Conclusion

The natural habitat for municipal bonds is taxable accounts. The bonds are subject to complex tax treatment whether they are held to maturity or sold earlier. Gain or loss resulting from sale depends on the holder's basis. If a bond is purchased at a deep discount and sold prior to maturity, some of the gain may be taxed as ordinary income and the rest as a capital gain.

We considered two tax-driven strategies to enhance after-tax performance. The motivation for a selling a loser is to recognize the loss when the market value of a bond falls below the holder's basis. Selling a winner is applicable to a bond purchased at a deep discount whose price subsequently surges. The motivation is to pay taxes earlier at the long-term capital gains rate, rather than at maturity at the ordinary income tax rate. Our analysis assumes that there are off-setting gains and losses in the investor's portfolio.

A key input into the calculation of the benefit from sale is the 'hold value' — this depends on the date and price of purchase, and can substantially differ from the prevailing market price. The calculation of the hold value requires OAS-based analytics. The difference between the after-tax proceeds from sale and the 'hold' value reveals whether or not selling would be beneficial. If it is so, determine whether to act now or wait. This calculation requires valuing the 'tax option' and the corresponding efficiency of selling. Sale is recommended only if the resulting benefit captures a high percentage of the forfeited option value. The benefit resulting from selling a loser can be significant, particularly if the holding period is less than one year, so the loss is short-term. The benefit from selling a winner is likely to be modest.

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