

The Timing of Advance Refunding of Tax-Exempt Municipal Bonds

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The tax-exempt municipal bond market totaled \$1.4 trillion in 1997. That year alone, \$267 billion in new municipal issuance came to market, 95 percent of which was long-term debt (PSA 1998).

Once a debt issuance becomes callable, the municipality can undertake a *current refunding* by issuing new, lower-coupon debt to finance the retirement of the outstanding issue. This is no different, except for terminology, from the calling and refunding of taxable corporate debt.

Even prior to the call date, however, municipal issuers may be able to lock in savings should interest rates decline. This is accomplished by issuing new tax-exempt debt of roughly matching maturity and using its proceeds to defease the outstanding obligation to its first call date. The defeasing portfolio consists of market-traded Treasury securities and other government obligations. Once defeased, the original bonds effectively share the same rating as Treasury obligations and should experience a concomitant increase in market value. This process is commonly referred to as *advance refunding*. The total volume of refundings, both current and advance, was \$80 billion in 1997 and is estimated to be about \$66 billion in 1998.

The fundamental and hotly debated consideration in this transaction is the choice of timing. Refunding entails interest rate risk, and investment banks have often been accused of advising municipalities to “pull the trigger” at unrealistically low savings thresholds. With the volume of advance refunding running in the tens of billions of dollars annually, the

timing decision is both theoretically challenging and of considerable practical significance.

Many practitioners rely on rules of thumb that were developed before the advent of modern option pricing theory and accessible technology. A common rule of thumb is the 5 percent rule, which states that an advance refunding should be undertaken if the cash-flow savings generated is at least 5 percent of the net present value of the bond. This approach is seriously flawed. The proper methodology for decision making, as we will discuss more fully, is to compare the cash-flow savings to the embedded total option value in the bond. Once this ratio reaches a specified threshold, the trigger should be pulled. The potential cash-flow savings could equal the entire option value yet not equal 5 percent of the net present value of the bond. The issuer in this case, following the 5 percent rule, would not exercise the advance refunding option when it is absolutely proper, and efficient, to do so.

In this article we apply standard option-based methodology to determine the optimum timing of an advance refunding. We consider standard municipal bond structures and a typical upwardly sloping tax-exempt yield curve. Our primary conclusion is that a standard long-term municipal bond should not be advance refunded unless the maturity matched refunding rate is at least 110 basis points below the bond's coupon rate. However, the transaction should be undertaken once this spread has widened to 150 basis points. In the case of an intermediate-term bond, the spread between its coupon and the refunding rate should be wider.

Our analysis isolates the financial component of the decision to advance refund. These results provide a scientific foundation for decisions that traditionally have been based more on intuition than on rigorous financial analysis. There are, however, other issues that may influence an issuer's decision. A borrower may advance refund, for example, to evade existing bond covenants, to consolidate a number of debt issues, or to alter its existing liability maturity structure. Political factors may also influence an issuer's debt management decisions. There are, of course, legal and legislative issues that must also be considered in an advance refunding and are not addressed here.

The remainder of this article discusses some of the practical considerations involved with carrying out an advance refunding, including legal and regulatory concerns. A review of the basics of option valuation and the concept of refunding efficiency is extended to the valuation of the advance refunding option. We then provide an example of an advance refunding to highlight some important relationships. Finally, we present our conclusions, along with general guidelines that can be used to evaluate advance refunding opportunities, and discuss some further areas of interest.

TACTICAL ISSUES

Advance refunding and related escrow transactions generally require the contemporaneous execution of a complex, interdependent, and dynamic series of transactions. Existing debt is retired through the issuance of new securities, whose proceeds are invested in a defeasance escrow.¹

Indenture covenants may restrict issuers' refunding choices. A municipal issue may consist of many parts that mature serially over many years. Such *serial bonds* often contain provisions mandating that any refundings be done in order of maturity, with the shorter dated issues refunded first.² The escrow created is tailored precisely to service the retired debt. At the same time, it must meet IRS restrictions.

The Tax Reform Act of 1986 ("1986 Act") set limitations on the number of "generations" of advance refundings permitted. If the original "new money" financing was issued on or after January 1, 1986, those bonds (or any subsequent refunding bonds) may be advance refunded once. New money bonds issued prior to January 1, 1986, may be advance refunded twice. All advance refundings done prior to March 15, 1986, count as one advance refunding toward the two-refunding limit.

Defeasance must be to the outstanding bond's first call date. This excludes the possibility of defeasing to later call dates or establishing an escrow with an unspecified termination date.

Corporate tax-exempt bonds, unlike their municipal counterparts, may not be advance refunded through a defeasance. Nevertheless, corporations can still take advantage of lower interest rates prior to the first call date through an outright repurchase and simultaneous refunding of their bonds (Kalotay, Williams, and Pedvis 1994).

Federal legislation has existed since 1969 restricting state and local governments from earning arbitrage profits by investing bond proceeds in higher-yielding investments. The 1986 Act introduced a *rebate* procedure requiring that any earnings from the escrow in excess of the yield on a maturity-matched refunding issue be rebated to the federal government.

To help facilitate the meeting of escrow earnings restrictions, the federal government established the State and Local Government Series (SLGS) securities program in 1972. SLGS securities can be purchased only by state and local government entities and municipalities with proceeds that are subject to yield restrictions and arbitrage rebate requirements. SLGS securities can be subscribed for at any rate, with a maximum

1. It is possible to defease an issue with cash; however, we address the issue of defeasances accomplished through advance refundings.

2. A given call premium applied to a short-dated security is more costly to refund than if applied to a longer-dated security.

permissible subscription rate of five basis points below the Treasury borrowing rate for a security of comparable maturity.

The Treasury permits an issuer to subscribe for SLGS securities up to 60 days prior to their scheduled issue date and then to cancel that subscription within five days of the issue date for subscriptions of \$10 million or less and within seven days for subscriptions of more than \$10 million, without penalty.³

The ability to cancel a SLGS securities subscription without a monetary penalty led some market participants both to subscribe for SLGS securities and to enter into a contract for the purchase of securities on the open market for the same defeasance transaction. The federal government felt that this was the equivalent of the creation of a call option on the SLGS securities, for which it was not being compensated. To eliminate this activity, the Treasury recently mandated that the amount of SLGS securities a municipality has subscribed for plus all securities already in the escrow, or acquired to be placed in the escrow, between the date of subscription and the date of issuance cannot exceed the total amount needed for such escrow (*Federal Register* 1997).

The purchase of securities for the escrow is typically performed via an investment bank. Sometimes this is the same bank used to underwrite the refunding bonds. Many municipalities view it as prudent to separate these transactions, however.

The price of the portfolio ultimately offered to the issuer must be "held firm" while the issuance's yield is made final and while the issuer, bond counsel, and financial adviser decide whether to proceed, often for periods of one hour or more in a shifting market. Any purchase of the escrow securities is on a forward delivery basis, usually weeks in the future, to coincide with the scheduled closing of the refunding issuance.

The escrow provider must deliver a portfolio that both precisely defeases the outstanding bonds and complies with applicable arbitrage restrictions as interpreted by bond counsel. Specifically, the provider must identify and deliver Treasuries that will generate appropriate payments at or before the time that payments on the refunded bonds will come due. To minimize "dead time" in the escrow (the time between the receipt of payments on the Treasuries and the payment dates on the refunded bonds), the payment dates on the Treasuries should precede the payment dates on the refunded bonds by a relatively short interval. Some issuers enter into

3. There is no monetary penalty assessed; however, the issuer is precluded from subscribing for SLGS securities for a six-month period.

forward repurchase agreements for cash flows that are affected by timing discrepancies.⁴

ADVANCE REFUNDING OPTION

Advance refunding is an option exercise. When rates have declined, advance refunding locks in interest savings. Simultaneously, the opportunity to refund at a later date is forfeited. This includes the opportunity both to advance refund at a later date and to current refund once the bond becomes callable. When making the decision to advance refund, this forgone option value must be compared to the realizable savings.

Refunding is a trade-off between the benefits (as measured by net present-value savings) and the cost (as measured by forfeited option value). The benefits are evident and easily quantifiable; the value of the option, on the other hand, is elusive. The rate at which a municipality can issue a refunding bond can be easily obtained from syndicate desks on a specified date. Arbitrage-free valuation techniques can determine the value of an option, given prevailing market conditions (Fabozzi, Kalotay, and Williams 1993).

Arbitrage-free valuation emerged around the mid-1980s. In a nutshell, it assigns a value to any bond, with or without an option, based on the prevailing yield curve and the assumed interest rate volatility. The value of the option is the difference between the values of a bond with the option and its optionless counterpart.

What is the right volatility? Although the answer is somewhat subjective, currently most professionals would consider 8 percent to 9 percent the appropriate range. As an aside, we should point out that the volatility for derivative products is higher than for bonds.

REFUNDING EFFICIENCY

We have sketched how one can compute savings from refunding a debt issuance on the one hand and forfeited option value on the other. The decision to refund should be based on the relative value of these quantities. Refunding efficiency provides the benchmark. The refunding efficiency is the percentage of the option value captured through present-

4. For example, if a payment to be generated by the escrow some time in the future will not be needed until a week after it is generated, an agreement is entered into today to lend that money for that week in the future.

value cash-flow savings when higher-coupon debt is replaced with a lower-coupon issue (Boyce and Kalotay 1979).

What level of efficiency should trigger a refunding? The bond should definitely be refunded at 100 percent efficiency, because the full value of the option would be captured through discounted cash-flow savings. At 100 percent efficiency, the clock is running; interest is accruing at an above-market rate, and waiting is purely speculative.

Efficiency from a formal option exercise cannot exceed 100 percent. Whether an option should be exercised at an efficiency below 100 percent depends on risk preferences. An embedded option is an illiquid asset, similar to an employee stock option. The holder may choose to exercise it to extract some of its value, even when doing so is less than optimal. We would consider 90 percent efficiency the minimum acceptable level, and as the markets become more efficient this level should be raised.

VALUATION OF THE ADVANCE REFUNDING OPTION

Conceptually, the analyses of advance refundings and current refundings are similar. The value of the option that would be extinguished has to be calculated and compared to the savings available from refunding. If the efficiency is sufficient, the issuer should execute the transaction.

When evaluating an advance refunding opportunity, we must consider the total optionality embedded in the bond. The option forsaken includes advance refunding at a later date and current refunding once the bond becomes callable.

The advance refunding option (ARO) is intimately tied to the call option. In the absence of a call option, the ARO has no economic value. An advance refunding locks in the call exercise—an issue that is advance refunded will be called at the first call date (at the previously set call price). The value of the ARO should therefore be measured incrementally above that of the call option.

The total option value can also be decomposed into its intrinsic value and time value. The intrinsic value of the option is based on the assumption that interest rates follow today's forward rates. The time value is the difference between the actual and intrinsic values.

Contemporary valuation technology can be extended to the total optionality, including the ARO. Relevant factors include the shape of the yield curve, interest rate volatility, and the return on the escrow.

AN EXAMPLE⁵

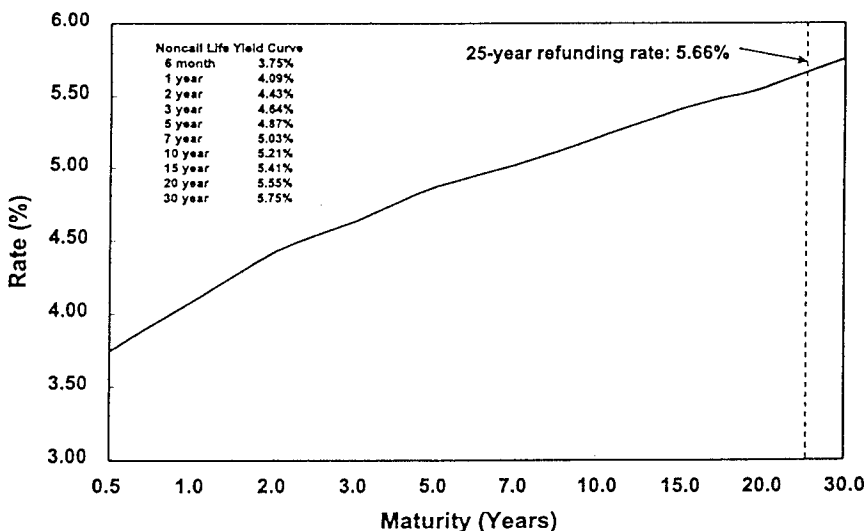
We consider for refunding a \$100 million face-amount term bond with a 30-year maturity. The issue originally carried 10 years of call protection. It has been outstanding for five years. The first call is therefore in five years at a price of 102, declining to 101 the following year and 100 thereafter. The issuer is assumed to be facing a normal, upwardly sloping, tax-exempt yield curve (Figure 1).

We assume there is no negative arbitrage—that is, that the escrow created to defease the issue, under market conditions, can earn the maximum allowable return. If it could not, a situation of negative arbitrage would exist. The presence or possibility of negative arbitrage affects the savings generated by advance refundings, but it does not affect the value of the option. Hence, the efficiency criterion can be applied whether or not negative arbitrage is a problem.

The net present-value cash-flow savings achieved through an advance refunding is the difference between the discounted scheduled principal and semiannual interest payments on the existing debt, minus that on the refunding debt. These cash flows must be discounted at the appropriate issuer-specific spot rates.

The refunding issue must be large enough to purchase an escrow that will generate the cash flows necessary to meet interest payments and the

FIGURE 1. Assumed Municipal Yield Curve



5. All option valuations were performed with Andrew Kalotay Associates' proprietary MuniVal software.

initial call price (which includes the call premium) on the outstanding debt through the first call date. The size of the refunding issue can be obtained by discounting these flows. The proper discount rate is the 25-year rate of 5.66 percent, since this is what the escrow can earn.

If the coupon rate on the outstanding bond is 7 percent, the present value of the 10 semiannual interest payments of \$3.5 million and a call of \$102 million in five years is about \$107,278,000. This is the amount of new 25-year debt that needs to be issued to fund the escrow adequately.⁶

The present-value cash-flow savings is then the discounted scheduled interest and principal payments on the outstanding bond (to maturity, discounted using the issuer's spot rates) less those of the new issue. In this case, the present-value cash-flow savings is about \$10,891,145 (Table 1). The savings is then compared to the value of the relinquished optionality. The ratio of present-value cash-flow savings to total option value is the advance refunding efficiency.

Interest rate volatility affects the total option value. The higher the volatility, the more likely it is that interest rates will be lower in the future and hence produce greater cash-flow savings. The ability to wait, the option, therefore becomes more valuable as volatility increases. Note that the option's intrinsic value does not change.

Total option value increases with both volatility and the coupon rate on the bond to be refunded (Figure 2). As the coupon rate climbs, the options go deeper in the money (the cash-flow savings grows) and volatility becomes less unimportant. At volatility levels of 9 percent and below, the total optionality converges to its intrinsic value for coupon rates of 7 percent and more as the time value of the options falls to zero. A zero percent volatility level will yield the intrinsic value of the option (Figure 3). Without volatility, there is no chance that interest rates will fall and make the environment more favorable for option exercise.

As the coupon increases, the intrinsic value of the call option rises at a much faster rate than that of the ARO. The growth in the ARO value declines quickly, while the call option value increases with the coupon rate on the refunded issue.

From the exhibits below, the following observations can be made:

- Increasing volatility does not alter this relationship (Figures 4 and 5). However, at higher volatility levels, the ARO values are smaller.
- At a given level of volatility, the ARO value increases with the coupon rate on the debt to be refunded. The higher the coupon on the outstanding debt, the greater the savings that can be realized through refunding.

6. For the sake of simplicity, underwriting fees and other transaction costs are assumed to be zero.

TABLE 1. Cash-Flow Analysis

<i>Period</i>	<i>Original Cash Flow</i>	<i>Replacement Cash Flow</i>	<i>Incremental Cash Flow</i>	<i>Discount Factor</i>	<i>Present Value</i>
1	\$3,500,000	\$3,035,763	\$464,237	0.98160	\$455,693
2	\$3,500,000	\$3,035,763	\$464,237	0.96029	\$445,802
3	\$3,500,000	\$3,035,763	\$464,237	0.93824	\$435,565
4	\$3,500,000	\$3,035,763	\$464,237	0.91592	\$425,203
5	\$3,500,000	\$3,035,763	\$464,237	0.89345	\$414,773
6	\$3,500,000	\$3,035,763	\$464,237	0.87100	\$404,349
7	\$3,500,000	\$3,035,763	\$464,237	0.84892	\$394,101
8	\$3,500,000	\$3,035,763	\$464,237	0.82721	\$384,021
9	\$3,500,000	\$3,035,763	\$464,237	0.80591	\$374,132
10	\$3,500,000	\$3,035,763	\$464,237	0.78505	\$364,449
11	\$3,500,000	\$3,035,763	\$464,237	0.76434	\$354,835
12	\$3,500,000	\$3,035,763	\$464,237	0.74390	\$345,344
13	\$3,500,000	\$3,035,763	\$464,237	0.72384	\$336,033
14	\$3,500,000	\$3,035,763	\$464,237	0.70414	\$326,888
15	\$3,500,000	\$3,035,763	\$464,237	0.68481	\$317,914
16	\$3,500,000	\$3,035,763	\$464,237	0.66585	\$309,112
17	\$3,500,000	\$3,035,763	\$464,237	0.64726	\$300,482
18	\$3,500,000	\$3,035,763	\$464,237	0.62904	\$292,025
19	\$3,500,000	\$3,035,763	\$464,237	0.61120	\$283,743
20	\$3,500,000	\$3,035,763	\$464,237	0.59373	\$275,633
21	\$3,500,000	\$3,035,763	\$464,237	0.57669	\$267,723
22	\$3,500,000	\$3,035,763	\$464,237	0.56006	\$260,002
23	\$3,500,000	\$3,035,763	\$464,237	0.54383	\$252,468
24	\$3,500,000	\$3,035,763	\$464,237	0.52800	\$245,119
25	\$3,500,000	\$3,035,763	\$464,237	0.51257	\$237,954
26	\$3,500,000	\$3,035,763	\$464,237	0.49752	\$230,969
27	\$3,500,000	\$3,035,763	\$464,237	0.48286	\$224,161
28	\$3,500,000	\$3,035,763	\$464,237	0.46857	\$217,529
29	\$3,500,000	\$3,035,763	\$464,237	0.45466	\$211,069
30	\$3,500,000	\$3,035,763	\$464,237	0.44110	\$204,777
31	\$3,500,000	\$3,035,763	\$464,237	0.42784	\$198,619
32	\$3,500,000	\$3,035,763	\$464,237	0.41491	\$192,619
33	\$3,500,000	\$3,035,763	\$464,237	0.40232	\$186,773
34	\$3,500,000	\$3,035,763	\$464,237	0.39006	\$181,079
35	\$3,500,000	\$3,035,763	\$464,237	0.37811	\$175,535
36	\$3,500,000	\$3,035,763	\$464,237	0.36649	\$170,136
37	\$3,500,000	\$3,035,763	\$464,237	0.35516	\$164,880
38	\$3,500,000	\$3,035,763	\$464,237	0.34414	\$159,765
39	\$3,500,000	\$3,035,763	\$464,237	0.33342	\$154,786

(continued on next page)

TABLE 1 (continued)

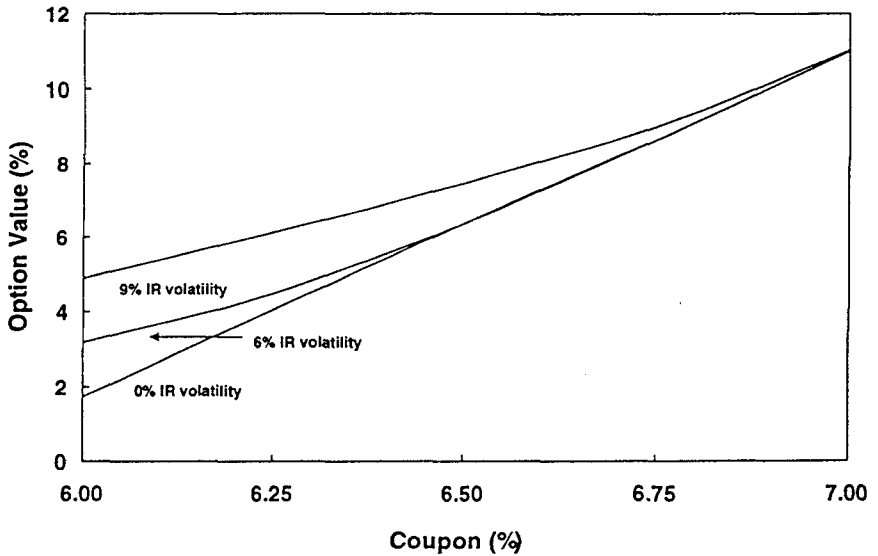
<i>Period</i>	<i>Original Cash Flow</i>	<i>Replacement Cash Flow</i>	<i>Incremental Cash Flow</i>	<i>Discount Factor</i>	<i>Present Value</i>
40	\$3,500,000	\$3,035,763	\$464,237	0.32298	\$149,941
41	\$3,500,000	\$3,035,763	\$464,237	0.31281	\$145,218
42	\$3,500,000	\$3,035,763	\$464,237	0.30291	\$140,622
43	\$3,500,000	\$3,035,763	\$464,237	0.29328	\$136,150
44	\$3,500,000	\$3,035,763	\$464,237	0.28391	\$131,799
45	\$3,500,000	\$3,035,763	\$464,237	0.27479	\$127,567
46	\$3,500,000	\$3,035,763	\$464,237	0.26592	\$123,450
47	\$3,500,000	\$3,035,763	\$464,237	0.25730	\$119,447
48	\$3,500,000	\$3,035,763	\$464,237	0.24891	\$115,553
49	\$3,500,000	\$3,035,763	\$464,237	0.24076	\$111,768
50	\$103,500,000	\$110,313,763	-\$6,813,763	0.23283	-\$1,586,430
Total:	\$275,000,000	\$259,066,150	\$15,933,850		\$10,891,145

- At a given coupon rate the ARO value declines with increasing volatility (Figure 6). As volatility increases, the value of refunding today diminishes in relation to the value of refunding at a later date.
- At a given volatility, the net present-value savings increases with the coupon on the debt to be refunded. For a given refunding rate, the higher the coupon on the outstanding debt, the greater the savings. The savings grows faster than the option value (Figure 7). Since advance refunding efficiency is the ratio of these two numbers, it rises with the coupon on the issue to be refunded.
- As volatility increases, the advance refunding efficiency declines (Figure 8). The cash-flow savings is not affected by interest rate volatility (only the level of interest rates affects it), but the option value increases.

The higher option value leads to lower efficiency, although with higher coupon rates the volatility becomes less important. In our example, a coupon rate of 6.67 percent on the refunded bond (110 basis points above the refunding rate) gives advance refunding efficiencies of over 90 percent regardless of the volatility level. These efficiencies rise to about 100 percent at a coupon rate on the refunded issue of 7.20 percent (154 basis points above the refunding rate).

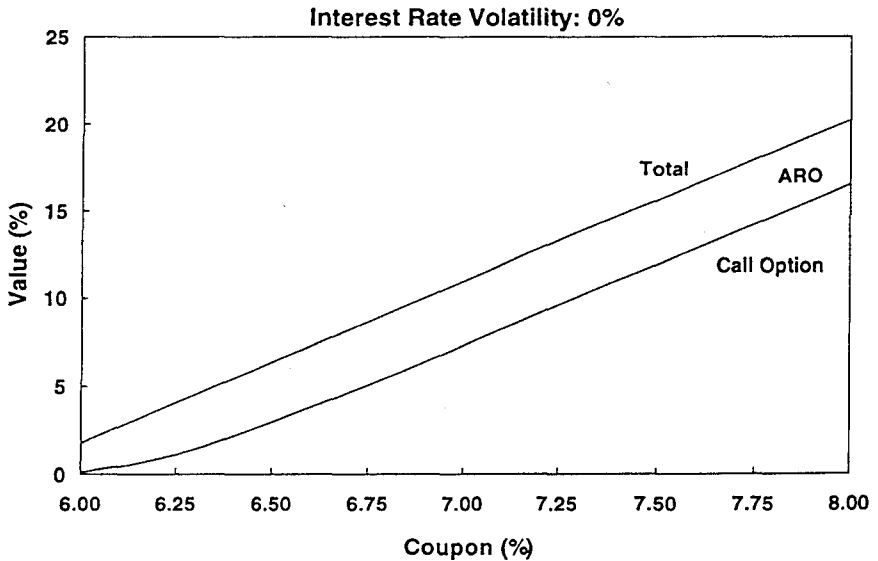
These results should not be applied too generally; each security has to be evaluated individually. For example, a 12-year bond noncallable in 10 years (a so-called noncall 10 bond) will command significantly higher spreads in year 5 because of the greater relative importance of the two-point call premium.

FIGURE 2. The Higher the Volatility, the Greater the Total Option Value (30-Year NC 10 bonds, five years prior to call)



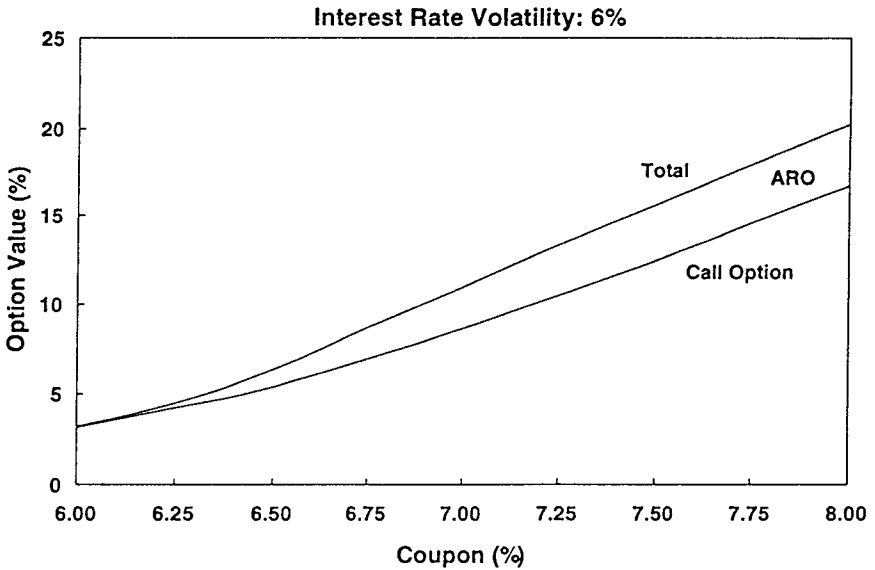
Note: The 25-year refunding rate is 5.66%.

FIGURE 3. The Higher the Coupon, the Greater the Option Value (30-year NC 10 bonds, five years prior to call)



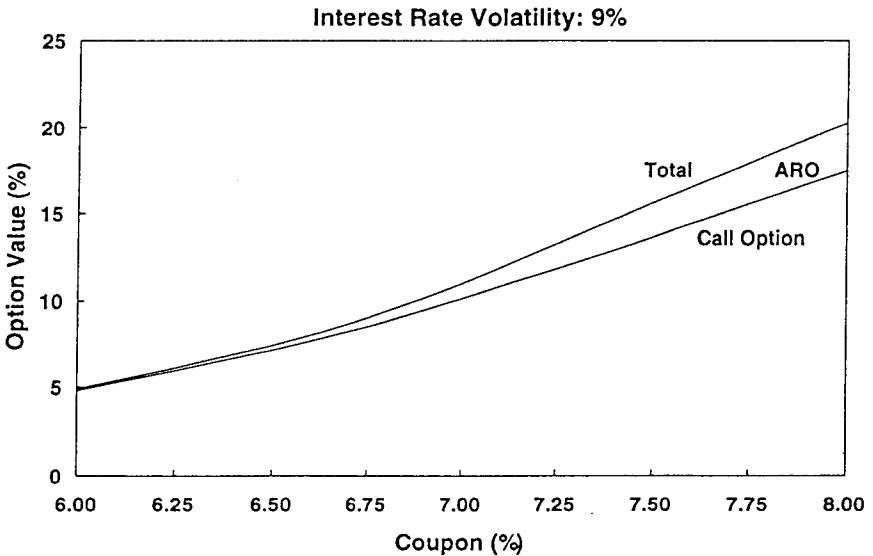
Note: The 25-year refunding rate is 5.66%.

FIGURE 4. The Higher the Coupon, the Greater the Option Value (30-year NC 10 bonds, five years prior to call)



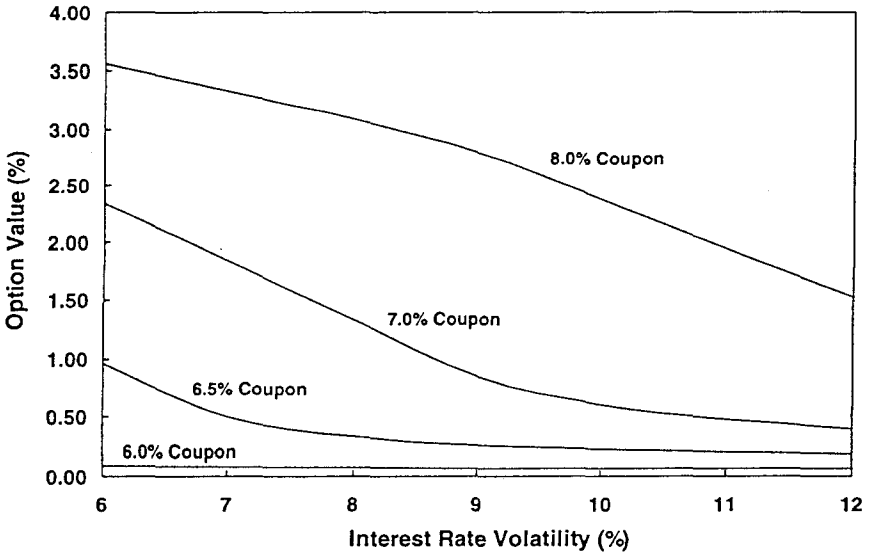
Note: The 25-year refunding rate is 5.66%.

FIGURE 5. The Higher the Coupon, the Greater the Option Value (30-year NC 10 bonds, five years prior to call)



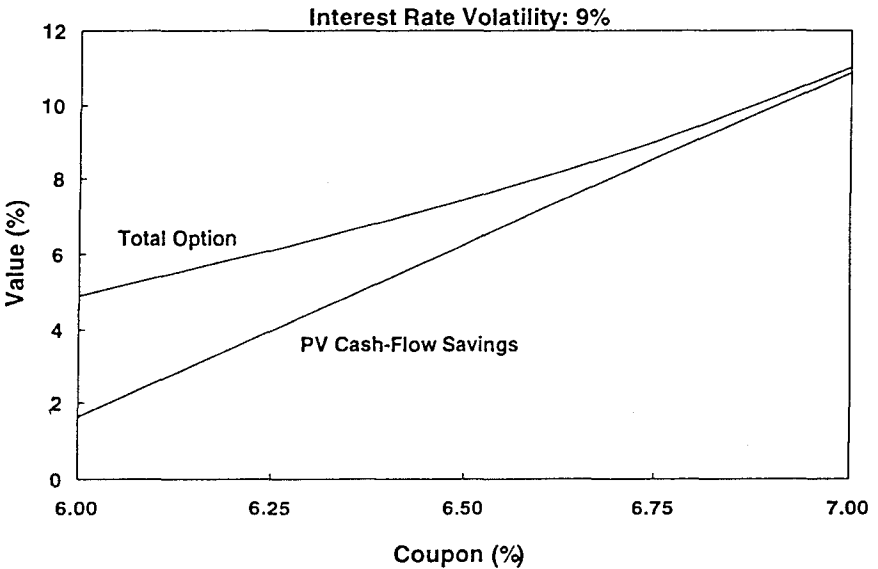
Note: The 25-year refunding rate is 5.66%.

FIGURE 6. The Higher the Volatility, the Lower the Incremental Value of the ARO (30-year NC 10 bonds, five years prior to call)



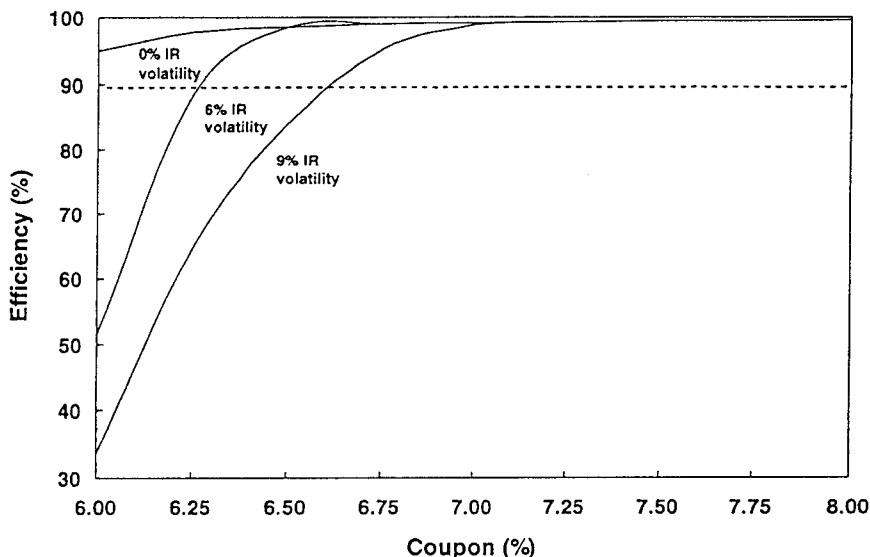
Note: The 25-year refunding rate is 5.66%.

FIGURE 7. At Higher Coupons, the Cash-Flow Savings and Total Option Value Converge (30-year NC 10 bonds, five years prior to call)



Note: The 25-year refunding rate is 5.66%.

FIGURE 8. The Higher the Volatility, the Lower the Advance Refunding Efficiency (30-year NC 10 bonds, five years prior to call)



Note: The 25-year refunding rate is 5.66%.

CONCLUSIONS

The preceding example provides useful guidelines for advance refunding tax-exempt debt. A standard 30-year noncall 10 bond should be advance refunded in year 5 when the spread between the refunding rate and the coupon on the outstanding debt reaches 110 to 150 basis points. Advance refunding at a spread below 110 basis points is wasteful because not enough of the option value is captured through cash-flow savings. Waiting at a spread above 150 basis points is purely speculative, because interest is accruing at rates substantially higher than current market levels.

Rules of thumb, no matter how useful, are no substitute for a rigorous option-based valuation approach. This approach must observe arbitrage rules as well as capture any mispricings of callable refunding bonds. The technology exists today to perform these kinds of analyses correctly.

The subject of advance refunding of tax-exempt debt is complex. Our discussion has shed some light on the important factors that go into the advance refunding decision. There is definitely room for further research. In particular, our analysis excluded negative arbitrage, now and in the future. Negative arbitrage occurs when the yield on the escrow is below the yield on the refunding issue. This results in more Treasury

securities' having to be purchased to generate the necessary payments to defease the outstanding debt.

The inclusion of possible negative arbitrage in the future introduces a second yield curve, that of the Treasury securities. We considered potential changes only in the issuer's yield curve. To model potential negative arbitrage scenarios, both the issuer's and the Treasury's yield curves would have to be considered simultaneously.

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