RATCHET BONDS: MAXIMUM REFUNDING EFFICIENCY AT MINIMUM TRANSACTION COST

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The *raison d'être* of callable bonds is that they can be redeemed (called) and refunded when interest rates decline. Although they are also useful when a corporation wants to retire debt with the proceeds of unanticipated asset sales or insurance payouts, the same can be achieved more cost-effectively using a "make whole" provision.[1]

Callable bonds have been used for decades by industrials and utilities. And, for financial institutions like Freddie Mac and Fannie Mae whose assets include fixed rate mortgages that prepay when rates fall, they are a virtual necessity

Although call options enable corporations to meet their objective of reducing interest expense in low-rate environments, there are several impediments to their efficient use. Foremost among these are the transaction costs associated with the refunding bond. In addition, poor execution—calling too early or too late—is common, causing a transfer of wealth from shareholders to bondholders.

How do we capture the advantages of callable bonds and eliminate their undesirable features? The solution is the Ratchet bond. Its coupon, which is indexed to the yield of a specified Treasury bond plus some fixed spread, resets as long as the resulting rate is lower than the one in effect. In other words, interest payments can only decline, they cannot rise. The cash flow pattern that emerges is similar to that generated by a sequence of callable bonds that are refunded with callable bonds of the same original maturity date.

The Tennessee Valley Authority was the first to use this innovative structure. In June 1998, they sold $575 million 6.75% "PARRS" with a 30-year maturity and annual rate resets beginning after five years, in 2003. As a point of historical interest, TVA's management was first introduced to the Ratchet structure by one of the present writers in a 1992 presentation. In 1998, TVA then brought this innovation *to Wall Street*—a virtually unprecedented occurrence, since ideas for new structures almost always flow in the other direction.

In this article, we describe the characteristics of callable bonds and show how Ratchet bonds can solve the problems of call inefficiency and recurring transaction costs. The perspective is that of the issuer but, recognizing that investors and intermediaries are interested parties, we briefly address their potential concerns as well.

1. Under a make whole provision, the call price is determined by discounting the remaining cash flows at a rate equal or close to the yield of a maturity-matched Treasury bond. Because this price exceeds the fair value of the bond, the holders are in essence "made whole," and therefore do not charge for the provision.

REVIEW OF CALLABLE BONDS

The distinguishing feature of a callable bond is that the issuer can redeem it prior to maturity at preset "call prices. These call prices tend to follow well-established industry conventions. For example, a 30-year 8% electric utility bond may be call-protected for 10 years, then become callable at 104 (par plus half a coupon). The call prices decline gradually to 100 by the end of year 20 and remain at par thereafter. Because the initial call price is above par, this bond is described as callable "at a premium.

In contrast to those of electric utility bonds, the call prices of U.S. Agency bonds are almost always par. A standard Agency bond has a 10-year maturity and is call-protected for three years. Recently, however, billions of dollars of 10-year Agency bonds were issued with call protection as short as three months, and many of these issues have in fact been called and refunded.

Because of the risk of being called when rates decline, the price of a callable bond is lower than that of an otherwise identical noncallable (or "optionless") bond. Equivalently, in order to command the same price, a callable bond has to carry a higher coupon than an optionless bond of matching maturity.

Studies of callable bonds tend to focus on the premium that the market charges for the call option at the time of issuance.[2] The theory of the pricing of callable bonds is well established,[3] and the corresponding computer-based valuation technology is readily available. This technology can also be used to calculate the call efficiency ratio discussed below.

Call Efficiency

How do issuers decide when to refund? The first step is to determine the savings—that is, compare the cost of calling the bond and refunding it at current market levels to the cost of leaving it outstanding to maturity. On a pre-tax basis, these savings are obtained by subtracting the total cost of calling (call price plus transaction costs) from the estimated fair value of the bond without the call option.[4] (The after-tax calculations are more complex and will not be considered here.)

The second, more difficult, step is to decide whether or not to "pull the trigger." The source of this dilemma is twofold. A drop in interest rates after a call leads to "caller's remorse," since the bond could have been refunded with a lower coupon had the issuer waited. But delaying the call and watching rates rise gives rise to "lingerer's remorse" because now the issuer has lost the opportunity to refund more cheaply.

Many issuers resort to rules of thumb to trigger a call. A common rule is to act when the net present value of the expected savings exceeds some specified percentage, say 5%, of the face amount outstanding. Another method is based on the yield differential between the outstanding coupon and the current rate. The call is triggered when a threshold of, say, 100 basis points is crossed.

While having the advantage of simplicity, these measures take no account of critically relevant information such as maturity, full call price schedule, shape of the yield curve, interest rate volatility, and institutional detail. To incorporate such variables into the analysis, William Boyce and one of the present writers proposed the concept of *call efficiency*.[5] Simply stated, call efficiency is the ratio of the savings from calling to the value of the forfeited option.[6] This ratio represents the percentage of the theoretical option value that the borrower actually captures. Since refunding costs reduce not only the savings but also the option value, leaving these costs out of the analysis—unfortunately, a common practice—will overvalue the call option and *understate* the efficiency.

Because the value of a call option is always at least as large as the savings (net of the refunding costs) that would result from exercising it, the maximum call efficiency is 100%. Exercising at a lower efficiency transfers value from the borrower to

2. See Bryan Stanhouse and Duane Stock, "How Changes in Bond Call Features Affect Coupon Rates," in this same issue of the *Journal of Applied Corporate Finance*, Vol. 12 No. 1.

3. For a discussion of recursive valuation using an interest rate lattice, see Frank Fabozzi, Andrew Kalotay, and George Williams, "Valuation of Bonds With Embedded Options," *The Handbook of Fixed Income Securities, 5th ed.*, (Chicago: Irwin Profession Publishing, 1997), p. 693-713.

4. See John Finnerty, Andrew Kalotay, and Francis Farrell, Jr., *The Financial Manager's Guide to Evaluating Bond Refunding Opportunities* (Cambridge, Massachusetts: Ballinger Publishing Company, 1988).

5. William Boyce and Andrew Kalotay, "Optimum Bond Calling and Refunding," *Interfaces* 9(5) (1979), p. 36.

6. Expressed as an equation, Call efficiency = (Fair Value of Optionless Bond - All-in Cost of Calling) / (Fair Value of Optionless Bond - Fair Value of Actual Bond).

Fair values can be obtained by using the recursive valuation procedure cited in footnote 3. In the case of optionless bonds, the cash flows may be discounted at the spot rates derived from the issuer's par yield curve.

TABLE 1
CALL EFFICIENCY: 5.90% AGENCY BOND CURRENTLY CALLABLE AT 100 WITH 7 YEARS TO MATURITY

Refunding Rate (%) (1)	**Present Value Savings from Calling and Refunding* (% of face) (2)**	**Option Value* (% of face) (3)**	**Call Efficiency (%) (4) = (2) / (3)**
5.05	4.839	4.839	100.0
5.15	4.237	4.263	99.4
5.25	3.638	3.774	96.4
5.30	3.341	3.554	94.0
5.35	3.045	3.346	91.0
5.40	2.749	3.156	87.1
5.45	2.455	2.979	82.4
5.50	2.161	2.814	76.8
5.55**	1.869	2.659	70.3
5.60	1.578	2.513	62.8
5.65	1.287	2.375	54.2
5.70	0.998	2.248	44.4
5.75	0.709	2.123	33.4
5.80	0.422	2.010	21.0
5.85	0.135	1.901	7.1

*Adjusted for refunding fees of 0.15% of face
**Current refunding rate

the bondholder. Failure to exercise a 100%-efficient call is also wasteful because "the clock is running"—that is, interest expense is accruing at an above-market rate.

Table 1 illustrates the calculation of call efficiency and its use to trigger a refunding in the case of a 5.9% agency bond with seven years to maturity. In the interest rate environment at the time of this writing (late February 1999, with the seven-year rate at 5.55%), calling this bond would result in savings of 1.87% of face value, while the option value is 2.66%. The ratio of these two numbers, namely the call efficiency, is 70.3%, which is too low to justify calling. When the refunding rate declines to 5.05%, call efficiency reaches 100%, indicating that the bond should be called immediately.

As shown in Figure 1, call efficiency drops sharply as interest rates rise. As rates decline, call efficiency rises until it reaches 100% at 5.05%, and remains at 100% at rates below this level.

Why Are Calls Exercised Inefficiently?

In an ideal world, we would expect to see calls occurring as soon as their efficiency reaches 100%. In practice, many calls are exercised at woefully inadequate efficiency levels. There are several reasons for this, the most obvious being the lack of an efficient market mechanism for selling embedded call options. If such a market existed, the proceeds from selling the option would exceed the savings from inefficient exercise.

Although the interest rate derivatives market does provide some means—forward contracts and swaptions—of "monetizing" call options, these instruments have their own complications. In particular, their potentially unfavorable accounting treatment and basis risk make most borrowers reluctant to employ them.

Reasons for premature call exercise range from the borrowers' risk aversion to their lack of analytical sophistication. In addition, there is the relentless pressure from investment banks to "churn" calling and refunding cycles. The waste resulting from these inefficient calls is significant.

For example, if the 5.90% agency issue featured above is called at a 70.3% efficiency (see Table 1), the savings to the agency would be 1.87% of face value. But the remaining 0.79% (2.66%-1.87%) of option value would revert to the bondholders. On a $100 million issue, this would amount to almost $800,000 of lost shareholder value. When one considers that the volume of calls is hundreds of billions of dollars annually, the magnitude of the transfer of value from shareholders to bondholders is staggering.

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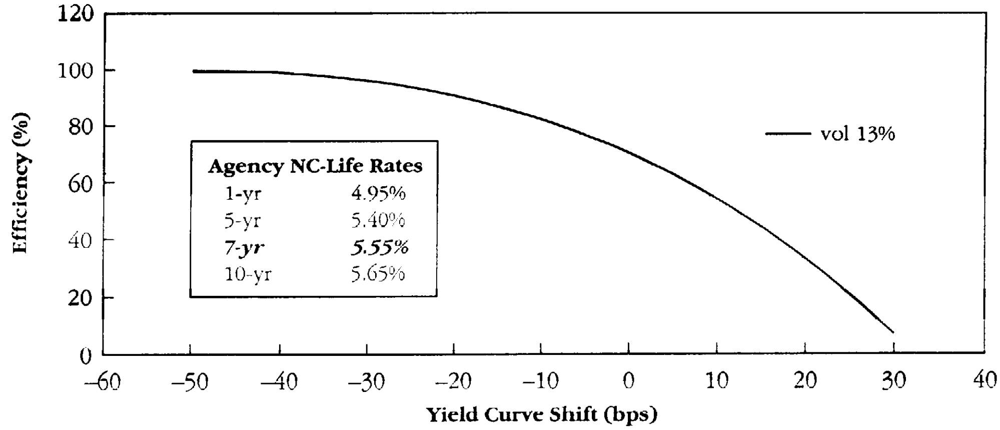
FIGURE 1
THE LOWER THE REFUNDING RATE, THE HIGHER THE CALL EFFICIENCY:
5.90% CALLABLE AGENCY BOND WITH 7 YEARS TO MATURITY



The flip side of premature exercise is an error of omission—that is, not exercising when one should. Unfavorable accounting can be a major cause of this phenomenon, because issuers have to recognize the call premium as an expense. Even though the longer-run impact of calling and refunding on corporate cash flow is clearly positive on a net present value basis, there is understandable reluctance to accept a hit to current earnings. After all, calling a $100 million issue at 104 reduces pre-tax earnings by $4 million; and especially if managerial compensation is tied to the firm's short-term financial performance, the immediate costs may appear to outweigh future benefits.

For regulated utilities, the accounting impediment is mitigated if they are allowed to amortize the call premium, but other considerations may come into play. Utilities prefer to delay reducing interest expense until completion of a rate case, regardless of call efficiency.

While the mechanics of calling a bond are relatively straightforward, issuing new debt (namely, the refunding bond) is not. Because disclosure requirements are onerous, corporations in the process of mergers and takeovers may decide to forgo the benefit from refunding during the pre-approval "quiet period." In the case of utilities, mandated regulatory approval for all fundings and refundings adds to the inertia.

Thus, in addition to the calls being exercised when they should not be, others go unexercised when they should. This latter phenomenon also diminishes the realized value of the call option and contributes to the transfer of wealth from the issuers to the bondholders.

In summary, managing callable bonds is a highly complex process for corporate and municipal issuers. Transaction costs are considerable, reporting and regulatory considerations abound, and the essential option-based valuation tools are not widely used by treasurers.

Valuing Callable Bonds

The information required to value callable bonds consists of the issuer's optionless (non-call life) yield curve and the interest rate volatility. Implied interest rate volatility, which is a critical variable in option pricing, can be estimated from the market prices of liquid callable issues. Volatility declines with credit quality, mainly because the investors in lower-credit bonds are more concerned about default than fluctuations in interest rates. For example, the implied volatility of Agency bonds is currently in the mid-teens, while that of BB-rated securities is below 8%. In discussing the valuation of callable bonds below, we use examples that involve Agency-type credits.

By taking the difference between the price of a callable bond and that of the underlying optionless bond, we obtain the value of the option. From the borrower's perspective a call option is an asset. To the bondholder, however, the call represents a liability—that is, the higher the value of the option, the lower the value of the callable bond. A byproduct of callable bond valuation is the effective (option adjusted) duration, which is essential for asset/liability management.

Instead of comparing the prices of otherwise identical callable and optionless bonds, there is

FIGURE 2
THE SHORTER THE CALL PROTECTION, THE HIGHER THE COUPON: NEW 10-YEAR CALLABLE AGENCY BONDS PRICED AT 100

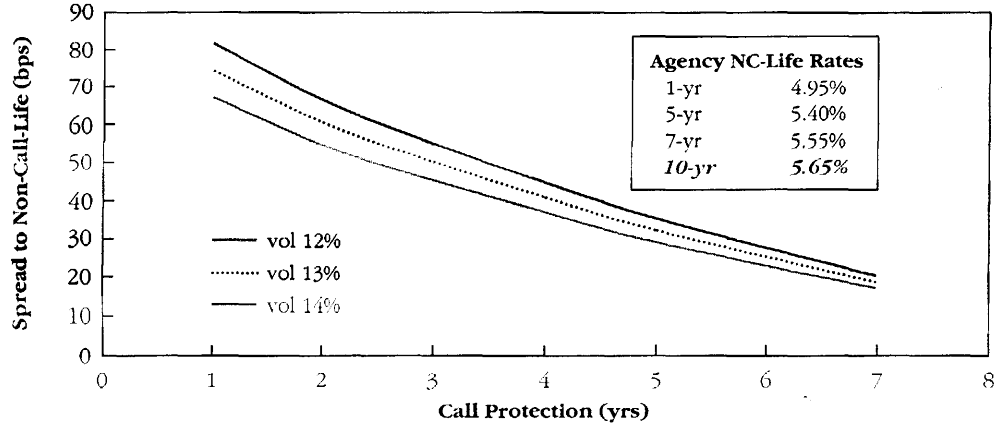
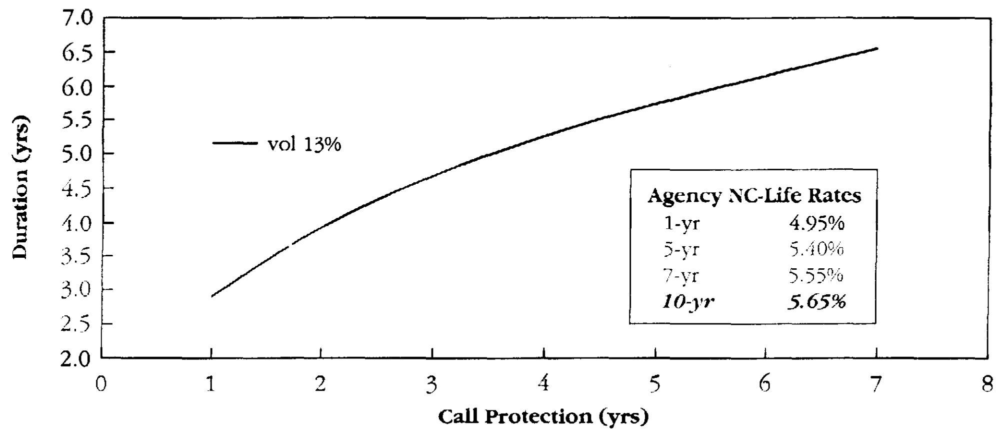


FIGURE 3
THE SHORTER THE CALL PROTECTION, THE SHORTER THE DURATION: NEW 10-YEAR CALLABLE AGENCY BONDS PRICED AT 100



another way to quantify the effect of the call option. For a given price, we can determine the fair coupon of a callable and an optionless bond, and then calculate the difference between these coupons. In this manner, we can determine by how much the call option should increase the nominal interest rate at the time of issuance.

Under the assumption the bonds are sold at par, Figure 2 shows how the initial call protection period affects the incremental coupon (expressed in basis points over the optionless rate) for callable Agency bonds with a 10-year maturity.[7] Given a short-term interest rate volatility of 13% (applied to the composite yield curve), the increment ranges from 18 basis points for seven years of call protection to 74 basis points for one year of call protection. Figure 3 shows that tightening call protection from seven years to one year shortens duration from 6.6 years to 2.9 years.

FUNDING WITH CALLABLE BONDS: THE BIG PICTURE

Before we introduce the Ratchet structure, consider a corporation that relies on callable bonds on an on-going basis as its basic borrowing vehicle. What cash flow pattern would arise from such a strategy?

The answer, of course, depends on the evolution of interest rates. On the one extreme, if rates trend upward, the bond will remain outstanding for

7. The results in this table and in all figures were obtained using the Black-Karasinski interest rate process with short-term volatilities as stated, and mean reversion set to zero. Treasury rates and Agency spreads are those prevailing as of late February 1999. An underwriting fee of 0.15% of face value is assumed for the refunding bond, if applicable.

PARRS have virtually all the advantages of conventional callable bonds but do not contain their well-recognized disadvantages for both borrowers and investors. Because the Ratchet bonds automatically lower interest payments when rates decline, the inefficiencies and transaction costs associated with calling and refunding are eliminated.

its scheduled life. But if rates decline, the bond will be called and refunded, presumably with another callable bond. As a result, interest payments decline. If rates continue to fall, the process repeats: the refunding issue is itself called and refunded, and so on. *This strategy gives rise to interest payments that decline if rates decline, and remain unchanged if rates rise.*

Let us summarize the salient features of callable bonds:

- Callable bonds enable borrowers to lower their interest expense when rates decline.
- At issuance, the coupon of a callable bond is higher than that of a maturity-matched optionless bond of the same price.
- The refunding issue that accompanies a call results in additional transaction costs.
- Calls tend to be exercised inefficiently, for reasons described above, causing a transfer of value from borrowers to bondholders.
- The strategy of refunding with callable bonds of the same original maturity date results in a "step-down" coupon pattern over time.

RATCHET BONDS

A Ratchet bond is an adjustable rate structure whose interest rate is periodically reset at a fixed spread over a market index, such as the yield of the 10-year Constant Maturity Treasury (CMT). The coupon "ratchets" only downward; it cannot increase. Thus a Ratchet bond replicates the cash flow pattern generated by a series of conventional callable bonds, as discussed above.

In terms of interest rate risk management, the Ratchet structure captures the desirable features and eliminates the aforementioned disadvantages of callable bonds. Because the Ratchet bond is not refunded when rates decline, there are no additional transaction costs. The reset is formula-based, so the inefficiencies commonly associated with call exercise are eliminated, and there is no need for additional managerial oversight. Moreover, because Ratchet bonds generate cash flows similar to those on callable bonds (more interest initially and less later on), they give rise to the same tax benefits that occur with callable bonds.[8]

Valuation

A Ratchet bond has a floating rate, but the coupon can only decline—a structure that is referred to as a floater with a zero period cap. On the one hand, because the coupon floats on an index such as the 30-year CMT rate, the precise treatment of the interest rate process that determines the index is critical. The technology for valuing such CMT floaters is the same as that used for interest rate derivatives. But it fails to take account of default risk, which is reflected in corporate credit spreads—the domain of corporate bonds and loans. Thus, the valuation technology required for Ratchet bonds must combine techniques from both realms.

Using these valuation techniques, we use Figure 4 to show how the initial lockout period affects the Ratchet bond coupon.[9] At a short rate Treasury volatility of 14% (which roughly corresponds to a 13% Agency volatility), the spread over the 10-year Agency non-call life coupon ranges from 16 basis points for a seven-year lockout to 56 basis points for a one-year lockout. The analogous results for callable bonds (shown earlier in Figure 2), you will recall, are higher. Figure 5 shows the duration of these bonds, which are comparable to those in Figure 3. By choosing the appropriate lockout period and reset frequency,[10] Ratchet bonds can be structured to achieve the particular interest rate risk profile desired.

The TVA PARRs

The Tennessee Valley Authority's PARRS issue is a revolutionary step in bond structuring. PARRS have virtually all the advantages of conventional callable bonds but do not contain their well-recognized disadvantages for both borrowers and investors.

The reset formula for the coupon was set at 94 basis points over the prevailing 30-year CMT. Using this formula, and with the 30-year CMT at 5.81% at the time of issue, the initial coupon was 6.75%. Beginning in year five, the coupon is reset annually according to the reset formula, provided that the new coupon is lower than the one in effect. Otherwise,

8. William Boyce and Andrew Kalotay, "Tax Differentials and Callable Bonds," *The Journal of Finance*, 34 (4) (1979), p. 825.
9. The valuations used in Figures 6 and 7 are provided by Andrew Kalotay Associates' *RatchetVal*. The same analytics are used to value the TVA PARRS as posted on the Reuters Terminal page KALOTAY/A.
10. More frequent resets increase the incremental coupon spread over the non-call life rate, and shorten duration.

FIGURE 4
THE SHORTER THE LOCKOUT PERIOD, THE HIGHER THE COUPON: 10-YEAR AGENCY RATCHET BONDS WITH ANNUAL RESET

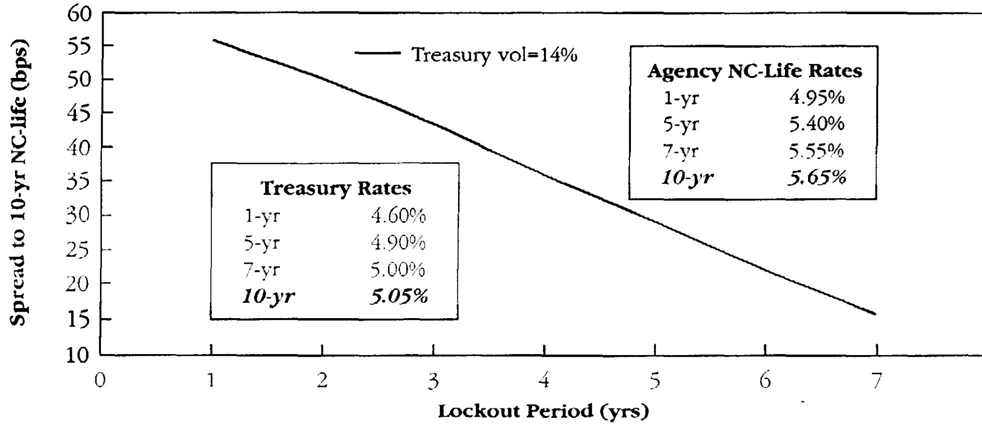
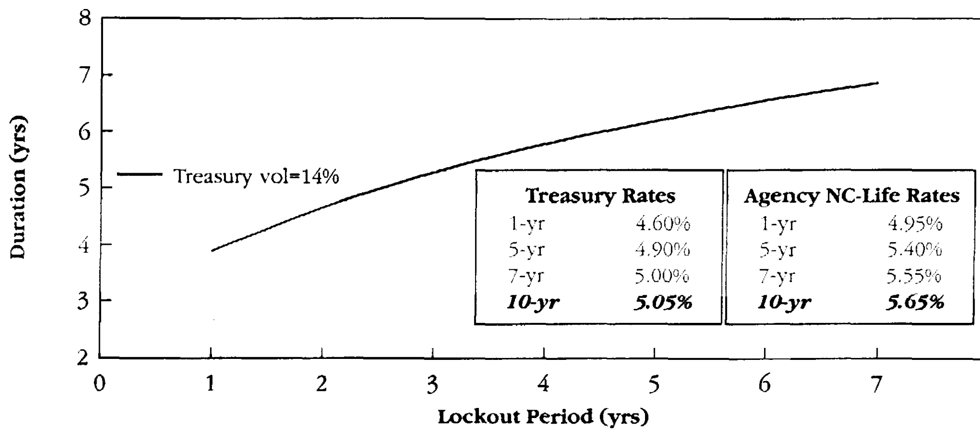


FIGURE 5
THE SHORTER THE LOCKOUT PERIOD, THE SHORTER THE DURATION: 10-YEAR AGENCY RATCHET BONDS WITH ANNUAL RESET



the coupon remains unchanged. As a result, interest expense declines with Treasuries, and never increases.

Investors should also prefer the TVA 6.75's to conventional long-term callable bonds. If rates trend upward and the coupon is never reset, the TVA PARRS provide a healthy yield premium (roughly 60 basis points) to optionless bonds. Of course, the coupon will be reduced automatically if interest rates decline, but no additional transaction costs will be incurred. Also the 94 basis point spread to Treasuries will remain unchanged as the bond rolls down the curve, making the new coupon a competitive rate at the time of a reset.

The TVA bonds also contain a contingent put-at-par feature. But, unlike the option granted investors in standard puttable bonds, which allows investors to put the bonds when interest rates rise, the put built into the TVA PARRS can be exercised by the holders *only when the coupon is lowered.* In such circumstances, since interest rates in general will also have fallen, the bonds will be selling at a premium to par *provided* the TVA's credit spread relative to Treasuries has not increased significantly. Thus, the contingent put provides investors with protection against deteriorating credit, but not against increasing interest rates, which is the norm for the put feature. While the contingent put was critical to the marketability of the TVA bonds, it is not an essential feature of Ratchet bonds.

Other Market Participants

Our discussion to this point has assumed primarily the perspective of the issuer, but we will now comment briefly on Ratchet bonds from the viewpoints of other participants. First, consider the investors. Buyers of Ratchet bonds should be willing to accept both the interest rate and credit risk associated with the structure. Thus, as long as they are

As a point of historical interest, TVA's management was first introduced to the Ratchet structure by one of the present writers in a 1992 presentation. In 1998, TVA then brought this innovation *to Wall Street*—a virtually unprecedented occurrence.

willing to hold callable bonds of similar credit and maturity, the Ratchet should be a preferred alternative.

The list of advantages of a Ratchet over a conventional callable bond, from an investor perspective, is similar to that for issuers. The usual reinvestment transaction costs are eliminated. In addition, there are none of the undesirable reporting and tax consequences that are associated with calls. Of course, investors can still actively manage Ratchet bonds, and this includes selling them, if desired.

On a national scale, the aggregate transaction costs associated with refinancing callable corporate, Agency, and municipal bonds are colossal. The volume being called obviously varies with interest rates, but recently it has been running at an annual rate in excess of $300 billion. The issuance costs vary, from 0.15% on the low end to above 3.5% on the other extreme, and we conservatively assume that they average 0.5% of face value. Under these assumptions, the aggregate annual cost to issuers is $1.5 billion. As discussed above, investors also incur considerable costs due to churning.

Because most of this money flows to brokerage and investment banking firms, these institutions are understandably less than enthusiastic promoters of the Ratchet structure. Other parties in the food chain include attorneys, printers, and rating agencies.

CONCLUSION

The main features of the Ratchet structure are as follows:

- The initial coupon is higher than that of a maturity-matched optionless bond.
- Interest payments decline as rates decline.
- The coupon steps down automatically so no additional transaction costs are incurred.
- The managerial finger on the trigger—essential in the cases of callable bonds—is unnecessary.

In sum, the Ratchet structure is likely to be a superior alternative to callable bonds. Because it automatically lowers interest payments when rates decline, the inefficiencies and transaction costs associated with calling and refunding are eliminated. Its valuation is analytically challenging, but the appropriate technology is available. In spite of underwriters' cool reception to the structure, the long-term prospects are promising, given the Ratchet bond's effectiveness in achieving lower interest costs without managerial intervention. In fact, as this article goes to press, the financial media have reported that TVA plans to sell another sizeable Ratchet issue, one whose structure is virtually identical to that of the PARRS issue featured in this article.

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