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Analysis of U.S. Savings Bonds

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U.S. savings bonds are complex contracts. Financial planners have traditionally paid little attention to savings bonds, in part because they often offer below-market interest rates. However, they sometimes offer above-market interest rates, especially when one learns how to view and value their option features. All savings bonds contain put options that protect the investor against a rise in interest rates. Thus, they can be viewed as short-term, intermediate-term, or long-term bonds. The EE bonds also offer several tax options. We show how savings bonds can be used to beat the kiddie tax, to finance postsecondary education, and in retirement planning.

I. INTRODUCTION

U.S. savings bonds are complex contracts. Today, the Treasury issues EE-series and HH-series savings bonds. Both series offer put options that protect the investor against the risk of rising interest rates. The EE bond also offers a number of tax options.

There has been little prior analysis of savings bonds. This lack of attention has not been due to the size of the market—at year-end 1992, individuals held $169.4 billion of U.S. savings bonds. Rather, the lack of attention probably reflects their complexity and the fact that they often offer below-market interest rates. However, interest rates on savings bonds are administered, and administered rates sometimes result in above-market yields.

The administered interest rates on savings bonds have occasionally exceeded market rates available on comparable Treasury securities. For example, from October 1992 through February 1993, the EE bond offered a minimum yield of 6% if held for five years, while five-year, coupon-bearing Treasury notes offered yields below 6%. In early 1993, several financial articles made this comparison. The rush to buy the above-market 6% savings bonds was so strong that at the end of February, the Treasury stopped issuing the 6% EE contracts. Funds invested in the 6% EE bonds continue to receive 6%.

Beginning in March 1993, new money invested in savings bonds had to settle for a 4% promised yield. The financial press and most financial planners failed to realize that the 4% yield still represented an above-market yield for some investors. Savings bonds contain a

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put option that allows investors to redeem the bonds at any time at a present price. Thus, a savings bond can be thought of as a short-term bond, an intermediate-term bond, or a long-term bond. For example, since the savings bond could be redeemed in six months at par plus 2% interest, the EE bond is also a six-month security offering a 4% annual yield. Until April 1994, yields on six-month marketable securities were consistently below 4%, often below 3%. Yet, few financial planners encouraged their clients to buy 4% EE bonds instead of lower-yielding near-cash assets.

We believe that most financial planners view savings bonds as a long-term security. The above example shows that learning to view a savings bond as a short-term or intermediate-term security can uncover important investment opportunities.

In addition to the put option, EE savings bonds offer several tax options. The tax options add yet another layer of complexity to these securities while offering other investment opportunities.

To repeat, U.S. savings bonds do not always present above-market yields, but they sometimes do. Financial planners must learn how to analyze savings bonds before they can recognize these unique opportunities. The purpose of this article is to demonstrate how these complex contracts can be viewed and used by investors. We use examples from 1993, but the approach can be applied to other times. We show how savings bonds can be viewed as short-term, intermediate-term, and long-term bonds. We also show how they can be used to beat the kiddie tax, to finance postsecondary education, and in retirement planning.

The article is organized as follows: section II looks at historic aspects of savings bonds and describes the terms of the EE-series and HH-series U.S. savings bonds; section III presents generic models of the bonds noting the option features; section IV values HH bonds and examines their competitiveness as short-term to long-term assets; section V discusses three tax-based strategies using EE bonds; and the last section presents conclusions.

II. THE EE AND HH SAVINGS BONDS

Series EE and HH savings bonds are the only ones currently being issued in the United States. For bonds issued after March 1, 1993, Table 1 shows the minimum redemption values by investment horizon on a $1,000 par value EE savings bond. It also shows the coupon interest payments on a $1,000 par-value HH bond.

The EE bonds are issued at 50% of face amount. They do not pay interest. Instead, the minimum redemption value grows at a 4% annual rate (compounded monthly). They must be held for six months before the redemption value rises, but it rises monthly thereafter at a 4% annual rate. If redeemed at maturity in 18 years, they would be worth at least $1,026.00. If held at least five years, EE bonds pay the higher of 4% or a market-based variable yield. The variable yield equals 85% of the average yield during the holding period on five-year Treasury notes. For example, suppose an investor buys an EE bond on March 1, 1993 and redeems it after five years. If the average five-year yield (as of the beginning of each six-month period) averages 5%, then the investor will receive 4.25% (5% × .85) instead of the 4% rate that is stated on the bond.

The HH bond offers a 4% annual (2% semiannual) coupon interest payment. Thus, a $1,000 bond pays $20 interest every six months. It must be held for the full six months to receive the $20 coupon interest. It can be redeemed at par at any time.

TABLE 1
The EE and HH Savings Bonds: Beginning March 1993

Period After Issue Date	*EE Minimum Redemption Values* (in dollars)*	*HH Coupon Interest (in dollars)*
At issue	500.00	NA
6 months	510.00	20
7 months	512.00	0
8 months	513.60	0
9 months	515.20	0
10 months	516.80	0
11 months	518.80	0
1.0 year	520.40	20
1.5 years	530.80	20
2.0 years	541.60	20
2.5 years	552.50	20
3.0 years	563.60	20
3.5 years	575.00	20
4.0 years	586.60	20
4.5 years	598.40	20
5.0 years	610.50	20
18.0 years	1,026.00	20

Note: *Since March 1, 1993, funds invested in EE savings bonds have offered a minimum return of 4% (compounded monthly) for up to 18 years. The bonds come in minimum denominations of $50 face value ($25 issue value). EE bonds must be held six months before the redemption value rises, but it rises monthly after six months at a 4% annual rate (compounded monthly). The table shows all redemption values through one year but only selective redemption values thereafter. An investor must hold the HH bond for the full six months to receive the $20 interest.

Each redemption value for EE and HH bonds represents a put option on the bond's price. For example, the investor can choose to redeem the EE bond for $510 in six months (that is, exercise the put option at $510), or redeem it at $512 in seven months, and so on. The HH bond contains an American put option with an exercise price of par. The next two sections analyze these put options in depth.

Table 2 gives other details of the EE and HH bonds. The minimum face value of EE and HH bonds are $50 and $500, respectively. Neither bond can be transferred and, therefore, they cannot be used as collateral. Thus, there exists no secondary market for the bonds. Each year, each investor can purchase up to $15,000 issue price ($30,000 par value) of EE bonds. HH bonds cannot be directly purchased. Rather, beginning six months after issue, EE bonds can be exchanged for HH bonds.

Savings bonds also offer important tax advantages. Interest on U.S. savings bonds is exempt from state and local taxes. Federal taxes must be paid on the coupon interest on HH bonds in the year in which it is paid. In contrast, the EE bonds offer several tax options. Table 3 summarizes these choices. The investor may choose to defer taxes until the bond is redeemed or matures (method 1) or pay taxes on the increase in redemption value as interest each year (method 2). Furthermore, the investor may change from method 1 to method 2 and pay taxes on all interest accrued to date. After filling out IRS Form 3115, the investor can also switch from method 2 to method 1. Most investors choose to defer taxes.

The tax treatment of the realized interest can take one of three forms.

TABLE 2
Terms and Conditions of EE and HH Savings Bonds Issued After March 1, 1993

	EE Bonds	*HH Bonds*
Minimum denomination	$50 par value	$500 par value
Issue price	50% of par value	Par value
Transferability	Not eligible for transfer No secondary market Not eligible for collateral	Same
Interest rate	The larger of 4% or a market-based variable rate. The latter denotes 85% of the average yield on five-year Treasury notes.	4%
Tax status	Interest can be: (1) reported as it accrues or (2) tax deferred until the bond is redeemed, exchanged, or matures, at which time the accumulated interest may be (a) taxed, (b) tax deferred yet again, or (c) partially or fully tax exempt.	Interest paid every six months. Taxable in year paid.
Original maturity	18 years	10 years
Final maturity	30 years	20 years

- It may be taxable in the year of redemption or at maturity.
- The redemption value can be rolled into HH bonds, in which case the interest continues to be tax deferred. For example, someone invests $5,000 ($10,000 face value) in EE bonds. In four years, they are worth $5,866. The investor could exchange the EE bonds for $5,500 of HH bonds and pay taxes on $366, or exchange the EE bonds plus $134 for $6,000 of HH bonds. In either case, the interest rolled into HH bonds is tax deferred until they are redeemed or mature.
- The interest may be partially or fully tax exempt if used to pay for qualified educational expenses. This tax option is popularly known as the Education Savings Bond Program. It is nothing more than an EE savings bond with interest deferred until redemption and used in the year of redemption to finance tuition and required

TABLE 3
Tax Options on EE Savings Bonds

Method 1: Defer taxes on accrued interest until

a. The bond is redeemed or matures, at which time taxes must be paid on accumulated interest;

b. The bond is exchanged for HH bonds, in which case interest rolled into HH bonds continues to be tax deferred; or

c. The bond is redeemed or matures and the proceeds are used in that year to pay for qualified postsecondary educational expenses. The accumulated interest may be partially or fully tax exempt, depending on one's level of income.

Method 2: Pay taxes on interest as it accrues. That is, pay taxes on the increase in redemption values as interest each year.

fees at most postsecondary schools. The bonds must be issued in one or both parents' names; they cannot be registered in the student's name. Moreover, the exemption is subject to an income limitation, which will be discussed later. For further details, the investor should read "U.S. Savings Bonds for Education," published by the Office of Public Affairs (U.S. Savings Bonds Division, Washington, D.C. 20226).

We examine tax-based investment strategies in depth in section V.

III. Valuation Models of Savings Bonds

Today in the United States, an individual can buy an EE savings bond or exchange an EE bond for an HH savings bond. In this article, we try to value the EE and HH savings bonds based on interest rates as of August 1993, the time of this writing.

The HH savings bond is the easier bond to value. Table 1 shows the coupon interest on today's 4% coupon, $1,000 par value, HH savings bond. The bond also offers an American put option that allows an investor to sell it at par at any time. Interest on the bond accrues every six months.[1] If interest rates rise sharply, it may be worthwhile to redeem the bond between accrual dates. However, the put option would most likely be exercised immediately after the $20 interest has been earned.

Because the put can be exercised at any time, it is simultaneously a six-month bond, a one-year bond, and so on, out to a ten-year bond. We can value this bond as if it has any of these maturities. As we will see, the savings bond offers a yield that is above current (August 1993) short-term yields and below long-term yields on marketable Treasury securities.

The basic model for HH savings bonds is:

$$V_{HH,n} = V_{str.,n} + V_{put,n}$$

where V stands for value and *HH, n* denotes an HH savings bond of n-year maturity, *str., n* denotes straight Treasury debt of n-year maturity; and *put, n* denotes an American put option with an exercise price of par on a n-year bond. Again, n can be any maturity from six months to ten years.

There does not exist a secondary market for savings bonds. Despite this, it is possible for the value of the savings bond to exceed par. For example, prior to March 1993 the HH bond offered a 6% coupon rate. Based on a yield of 5.31% on four-year, coupon-bearing Treasury notes, the straight debt value of the HH contract (when viewed as a four-year security) was $1.0246 (par = $1).[2] Although the put option was out of the money, its value was still positive. Thus, the true value of the savings bond was something in excess of $1.0246. The lack of marketability presents no problem for the efficient investor, who could buy the currently underpriced bond and hold it until it either matures or is no longer undervalued (at which time, he or she will exercise the put option on the bond).[3]

We see that the value of the HH bond, V_{HH}, can exceed par. However, the put option guarantees that the value can never be less than par. It follows that the value of the savings bond must be at least par: $V_{HH} \geq$ par.

Figure 1 shows the values of a 6% coupon, ten-year straight Treasury note and a 6% coupon, ten-year HH bond. When the market yield is well less than 6%, the value of the put option is negligible and the value of both bonds coincide. As the market yield approaches 6%, the put option becomes valuable and the value of the savings bond exceeds the straight

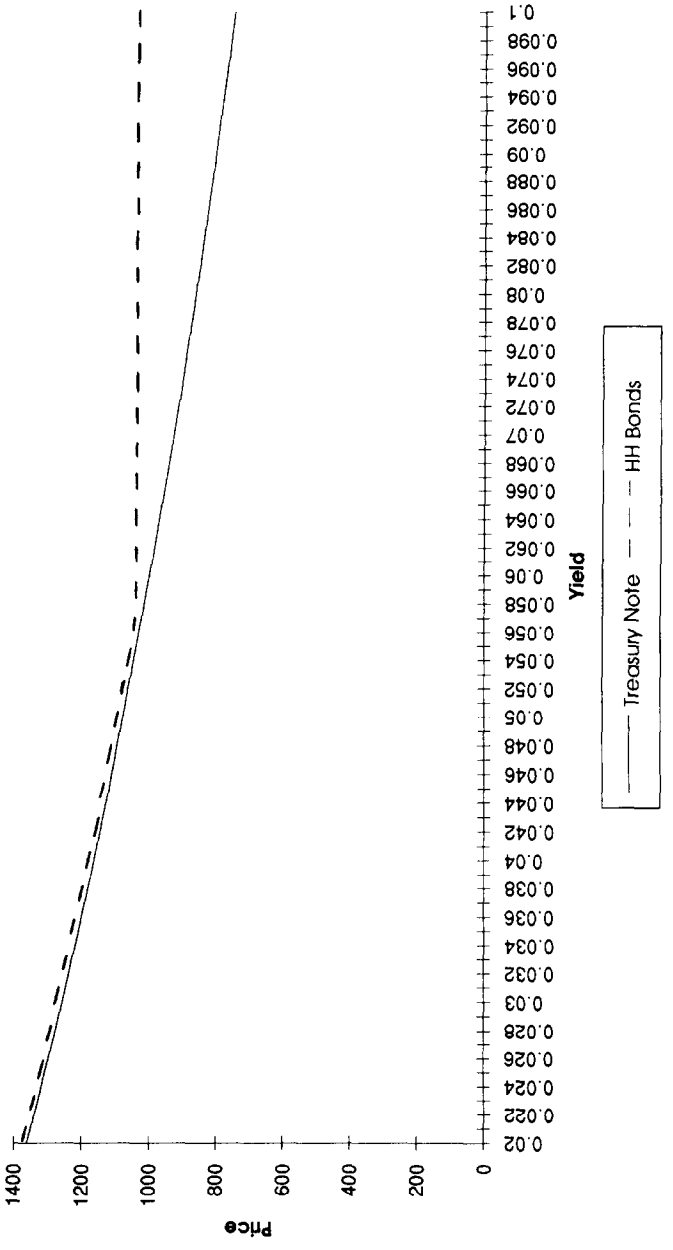

Figure 1. Price yield relations

debt value. For market yields above 6%, the put option dominates the valuation and sets the bond's value at par.

It is more difficult to value an EE savings bond than an HH bond. In addition to the put option, the EE bond offers several tax options. The value of the package of put and tax options is not equal to the sum of the separate options. As we shall see, investment strategies that are designed to capture the value of one option often limit the value of another option. For example, in order to get the tax exemption of interest, the investor may have to hold the bonds until his/her child enters college; that is, the investor must forego the put option until the child enters college.

The value of the put option in EE and HH bonds depends on the volatility of interest rates and other factors that do not vary with the investor. In contrast, the value of the tax options on EE bonds depends on individual tax rates and, thus, its value varies among investors. A general model for the value of an EE bond is: $V_{EE,n} = V_{str.,n} + V_{options\ package,n}$ where V denotes value and EE,n refers to the EE bond; $str.,n$ refers to the straight bond; and $options\ package,n$ refers to the package of put and tax options on an n-year bond.

If we ignore the value of the tax options, then the structure of the EE bond is very similar to the structure of the HH bond. The structural difference is that the accrued interest on the EE bond is "reinvested" at 4%, thus raising the redemption price or exercise price on the put option. In contrast to the HH bond, the EE bond guarantees a 4% horizon return; that is, there is no reinvestment rate risk on the EE bond. We cannot calculate the precise value of an EE bond because the value of the tax options depends on each investor's tax rate. However, the value of the HH-style bond represents a floor for the value of the EE bond.

IV. Valuing Savings Bonds with a Put Option

As we have seen, the HH bond is simultaneously a six-month bond, a one-year bond, and so on out to a ten-year bond. And the value of the HH savings bond equals or exceeds its straight debt value plus the put value. In this section, we use August 16, 1993 security prices to value the 4% coupon, HH savings bond when it is viewed as a six-month bond through a ten-year bond. We will see that the straight debt values and put values of the savings bond vary with maturity.

For each maturity, we compare investments in two securities: an investment in straight Treasury debt of the given maturity and an investment in the 4% coupon savings bond. Since both strategies use Treasury securities, we are comparing return prospects on investments of equal risk. In this section, we ignore the value of the tax options on EE savings bonds. Again, the value of the HH bond may be viewed as a floor value for the EE bond.

Figure 2 shows the yield curves on August 16, 1993 on the HH savings bond and coupon-bearing Treasury securities. There are two Treasury yield curves at any time: the yield curve on marketable debt and the yield curve on savings bonds. Again, the HH bond can be sold at par at any time. So, it is a bond with any maturity from six months through ten years. The 4% coupon on the savings bonds exceeds yields on straight debt for maturities less than 27 months. Therefore, for investment horizons between six months (the accrual period on HH bonds) and 24 months, the HH bond guarantees an above-market yield with no additional risk. We next try to value the HH bond for investment horizons from six months through ten years.

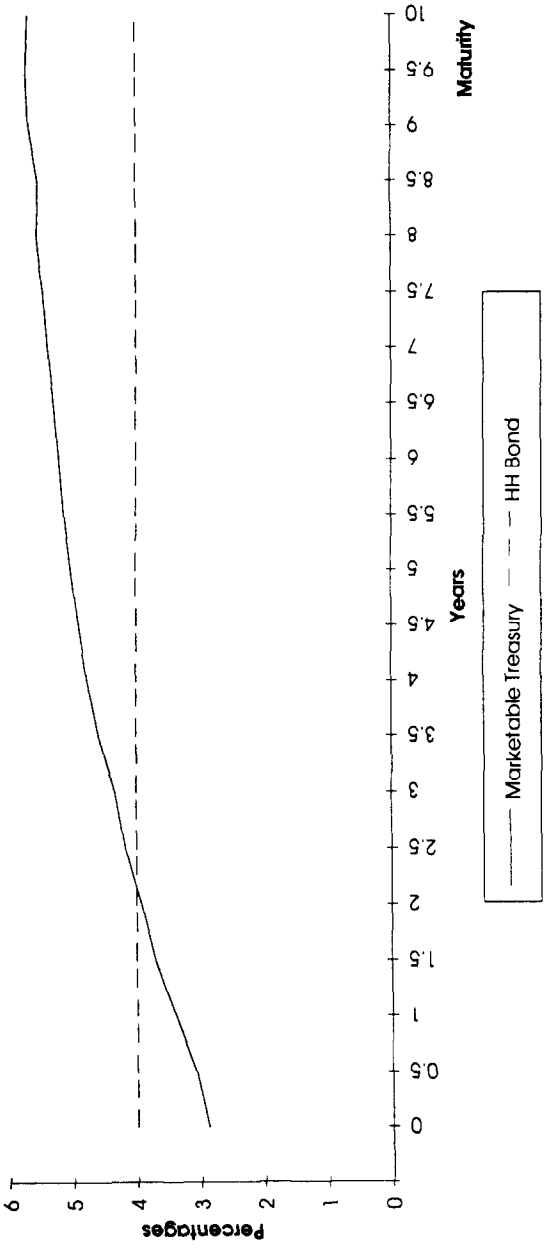

Figure 2. Yield curves of treasury coupon-bearing and HH bonds

A. Six-month Horizon

Based on a six-month Treasury bill discount interest rate of 3.11%, the straight debt value of a $1 savings bond is $1.0040.[4] This savings bond also contains a put option. However, the investor must hold the HH bond for the full six months to receive the 2% interest. Thus, unless Treasury yields rise sharply, the put option will not be exercised before the interest accrual date in six months. If we ignore the ability to exercise the put option before six months, the value of the HH bond is $1.0040.

Some investors place funds in money market funds, CDs, and other near-cash securities to reduce their exposure to interest rate risk. It is instructive to compare returns on savings bonds to returns from rolling over six-month CDs. On August 16, 1993, six-month CD rates were about 3%.[5]

The EE savings bond dominates the CD strategy. It guarantees the larger 4% annual interest rate for the first six months.[6] It also offers a series of contingent, European call options *on interest rates*. At the end of six months, the investor has the right to reinvest the funds at 4% for another six months. At the end of the second six months, the investor has the right to reinvest the funds again at 4%. In total, the savings bond offers a series of 35 contingent call option on the interest rate at 4%. If an investor ever decides not to "buy" the 4% interest rate for six months (i.e., he or she exercises the put option on bond price and redeems the bond), then he or she forfeits all subsequent call options.

Table 4 compares returns on the old EE bond bought before March 1993 to a strategy of rolling over six-month CDs. Suppose the EE bond, which promised at least 6% if held for five years, was bought in February 1993. At that time, the six-month redemption value on EE bonds translated into a 4.16% interest rate, or about 1.4% above the then-current six-month CD rates. The immediate yield advantage was just the beginning of the story.

Instead of redeeming the bond in six months (i.e., August 1993), the investor had the option to hold it for a second six months and earn a 4.39% annual interest rate, [{($521.60 − $510.40) / $510.40} × 2]. Since CD rates in August 1993 were about 3%, the investor should have opted to hold the EE bond and earn the 4.39% yield.

Table 4 shows the redemption value after each six-month period as well as the interest rate on the next six-month interest rate option. For example, in February 1994 the investor had the option of cashing in the bond at $521.60 or accepting the 4.75% interest rate option—that is, holding the bond for another six months and earning 4.75%. Interest rates on the series of options rise until they peak 4.5 years after issue at 8.18%. Between years 5 and 12, the redemption values grows at a guaranteed minimum rate of 6%.

The EE contract in February 1993 offered investors a real bargain compared to money market investments. First, it guaranteed a higher initial six-month yield. Second, their redemption values implied a series of interest rate call options, which protect the investor against falling interest rates. These investors may enjoy above-market yields for 12 years. Third, the put option provided protection against a rise in interest rates. Finally, the EE-bond offers the tax options that are not available on CDs.

The 4% EE-series savings bond is not as attractive as the 6% EE bond. However, it continued to offer investors a better return than money market investments through March 1994.

TABLE 4
Comparing Interest Rates on Six-Month CD and EE Bond: February 1993

Period After Issue Date	*CD Rate*	*EE Redemption Value (in dollars)*	*EE Rate (Beginning of Period)(%)*
At Issue	2.75%	500.00	4.16%
0.5 year	?	510.40	4.39%
1.0 year	?	521.60	4.75%
1.5 years	?	534.00	5.24%
2.0 years	?	548.00	5.55
2.5 years	?	563.00	5.97
3.0 years	?	580.00	6.76
3.5 years	?	599.60	7.20
4.0 years	?	621.20	7.86
4.5 years	?	645.60	8.18
5.0 years	?	672.00	6.00
5.5 to 11.5 years	?	—	6.00
12 years	?	1,016.40	No Guaranty*

Note: *No Guaranty: The guaranteed interest rate ends 12 years after issue.

B. One-year Horizon

Let us compare the returns on three investment strategies as of August 1993:

- Buy and hold a one-year, coupon-bearing note yielding 3.39%;
- Buy a 4% coupon savings bond, redeem it in one year; or
- Buy a 4% coupon savings bond, redeem it at par in six months, and reinvest at that time in a six-month Treasury bill.

The second strategy dominates the first; the straight debt value of the savings bond is \$1.0059.[7] The value of the put option reflects the ability to choose between the second and third strategies—that is, the choice to be made in February 1994 between accepting the 4% (annual) coupon on the savings bond or the then-current six-month Treasury yield.

To value the put option, notice that a put option on bond price is identical to a call option on interest rate. It gives the bondholder the right to buy a \$1 par value, pure discount, six-month bond in February 1994 at \$.9804 [\$1/1.02]—that is, to buy a 4% annual interest rate for six months. We will use current Treasury strip prices to value a call option on a forward contract that allows an investor to buy in February 1994 a \$1 pure discount bond maturing in August 1994. Based on August 16, 1993 prices, the implied six-month forward rate between February and August 1994 is 1.8258% and the corresponding price on the forward contract is \$.9821.[8] Thus, the option in the bond has an intrinsic value of \$.0017, or \$.9821 – \$.9804. Its actual option value would exceed this amount due to its time value. We thus conservatively estimate the value of the savings bond for an investor with a one-year investment horizon at V_{HH} = 1.0059 + .0017 = \$1.0076.

For the one-year investment horizon, it will be clear in six months whether the investor should exercise the put option. If in six months the six-month Treasury yield exceeds 4%, the put option should be exercised. If not, it should not be exercised. The next example shows that it is not always clear whether the put option should be exercised.

C. Two-and-a-half-year Investment Horizon

An investor could buy a 2.5-year, coupon-bearing Treasury note yielding 4.41% or a 4% coupon savings bond. The latter contains the put option that would most likely be exercised at the end of an interest accrual period in 0.5 years, 1.0 year, 1.5 years, or 2.0 years.

The straight debt value of the savings bond is \$0.9904 for a \$1 par-value bond.[9] The question is whether the put option, if sold separately in the financial market, would be worth \$0.0096 since the bond can always be redeemed at par. As part of the savings bond, the put option must be worth at least \$0.0096. If the put option sold separately is not worth \$0.0096, the savings bond is not a good investment for the person with a 2.5-year investment horizon.

The put option gives the investor the right to cash in the savings bond at par and reinvest the proceeds at the then-prevailing Treasury rate for the remainder of the 2.5-year horizon. It gives the investor the right to exchange the savings bond in six months for a two-year note, in one year for a 1.5-year note, in 1.5 years for a one-year note, or in two years for a 0.5-year note.

Is the put option worth the 0.41% initial yield disadvantage (4.41% -4%)? We do not know. If the yield on the initial 2.5-year note remains at or below 4.41%, then the straight debt will outperform the savings bond. If yields rise sharply, however, buying the savings bond, redeeming it at par after rates rise, and reinvesting at the then-current interest rate will produce the higher 2.5-year return.

The 2.5-year returns on straight debt and savings bonds will be approximately equal if the put option is exercised in six months when the two-year yield is 4.51%. The 10 basis point (4.51 – 4.41%) yield advantage for four six-month periods roughly offsets the 41 basis point disadvantage for one period. The savings bond would also produce an equal 2.5-year return if: (1) the put is exercised in one-year and the 1.5-year Treasury yield is 4.68%, (2) the put is exercised in 1.5 years and the one-year Treasury yield is 5.03%, or (3) the put is exercised in two years and the 0.5-year yield is 6.05%.

Suppose that in six months, the two-year Treasury yield is 4.6%. Should the investor exercise the put option? Exercising it and buying a two-year note would guarantee that the savings bond would produce a larger 2.5-year return than the original straight debt. However, once the put is exercised, the investor loses the protection against rising interest rates. If rates continue to rise sharply, the investor would be better off delaying the exercise; in essence, the put option offers the investor a one-time exchange of the savings bond for the then-current yield. What is the optimal strategy for exercising the put option?

Despite tremendous efforts, we cannot answer the question with precision. At least two issues make valuing an option on bond price more difficult than valuing an option on stock price. First, we cannot agree on the nature of the process driving interest rates. Are interest rate means reverting? Do they follow a random walk? In contrast, we agree (at least for option models) that stock returns follow a log-normal distribution.

To understand the second problem, note that the put option's value depends on bond price volatility and the probability distribution of future bond prices. Consider a stock currently priced at 40. The stock's volatility per unit of time is assumed to be constant, so the probability distribution of the stock price widens as the investment horizon lengthens. The same is not true of an option on a bond price. Through time, the maturity of the underlying bond shortens, which causes the volatility of the bond price to continually fall. For example, for the 2.5-year investment horizon, we had an option on a two-year bond in

six months, an option on a 1.5-year bond in one year, and so on. Moreover, the distribution of future bond prices is constrained by the guarantee that at maturity it will sell at par.

In short, it is not clear whether or not the savings bond offers a good deal for the investor with a 2.5-year investment horizon. The savings bond's straight debt value is $0.9904. If a separate put option would be worth more than $0.0096, the savings bond would be more than competitive. If less than $0.0096, it would be less than competitive. A key factor is the volatility of interest rates. The more volatile, the more valuable is the put option.

D. Ten-year Horizon

Ten-year, coupon-bearing Treasuries yield 5.89%. The straight debt value of the savings bond is $0.8587. The put option in the savings bond is thus worth $0.1413, because it allows it to be sold at $1.00 (par). It is clear that the value of the same option sold in the financial markets would be worth well less than this amount; the put option is so deep out of the money that it cannot be priced with current (August 16, 1993) market quotes. This implies that the HH savings bond offers a noncompetitive package for the investor with a ten-year investment horizon. If such an investor currently holds an HH bond, then he or she should exercise its overvalued put. If the bond's put is not exercised, it will likely lose value as the maturity of the underlying bond shortens.

V. Tax Strategies

In section IV, we examined the value of the put option. In this section, we examine several investment strategies that are based on tax options. The tax options on EE bonds were described in section II and summarized in Table 3.

A. Beat the "Kiddie Tax"

The "Kiddie Tax" section of the Tax Reform Act of 1986 was written to limit parents' ability to lower taxes by shifting income to their children. In 1993, for a child under age 14, unearned income in excess of $1,200 was taxed at the higher of the child's or the parents' marginal tax rate. This greatly reduces parents' ability to reduce taxes by shifting income to a child under 14. Once a child reaches 14, all of his or her income is taxed at the child's tax rate.

The EE bond offers parents the opportunity to shift earning assets to children under 14 without exceeding the income limit. Parents can register (i.e., buy) EE bonds in the child's name. Suppose a couple registers $10,000 (redemption value) of EE bonds in Johnny's name on his fourth birthday. At this point, the interest can be treated in one of two ways. First, Johnny can hold the bonds until he turns 14, when they will be worth at least $14,908. If redeemed, the $4,908 of deferred interest will be taxed at Johnny's tax rate. In the meantime, the parents can shift enough other assets into Johnny's name to fully use the income limit, currently $1,200, before he turns 14.

Second, if Johnny is not using the income limit, he can elect to pay taxes on the interest as it accrues. As of 1993, the first $600 of unearned income is tax free. Thus, if the $10,000 EE bond is the only asset in Johnny's name, he should claim the interest annually. In the first year, he will claim $408 of interest and pay no taxes. In the second year, he will claim $424 of interest and avoid taxes [$10,832 – $10,424]. If the accrued interest ever exceeds

the income limit, the parents can change the tax treatment from the accrual method (method 2) to the deferral method (method 1).

By registering savings bonds in a child's name, parents can help finance any future expense—summer camp, room and board at college, or college tuition. The next strategy can only be used to finance tuition and fees at most higher educational institutions.

B. Educational Savings Bond Program

The accumulated interest on EE bonds may be partially or fully tax exempt if used to pay for qualifying educational expenses. To qualify, the bonds must be issued after 1989. They can be purchased by anyone, but they must be issued in one or both parents' names. The bond cannot be issued in the child's name, but he/she may be registered as the beneficiary.

The bonds must be redeemed in the year the bond owner pays qualified educational expenses—tuition and fees—to an eligible educational institution. Room, board, and books do not qualify as educational expenses. Eligible institutions include colleges, universities, technical institutions, and vocational schools.

As of 1994, the full interest exclusion applies only to couples filing jointly with modified adjusted gross income of $60,000 or less. (Modified AGI is adjusted gross income before this interest exclusion.) The exemption is phased out as the couple's income rises until it is completely eliminated for couples with modified AGI above $90,000. The exemption also phases out for single filers. The corresponding 1994 amounts are $40,000 and $55,000. Since the Revenue Reconciliation Act of 1993, these limits are not indexed for inflation.

Some middle-income families can be reasonably certain that the EE interest will be fully tax exempt. These families might use EE bonds issued in the parents' names to finance tuition and fees and EE bonds issued in the child's name to finance room, board, and books.[10]

Figure 3 shows two term structures of interest rates for middle-income families. The first is the term structure for pure-discount Treasury strip securities. The second shows a flat term structure at 5.56%, which corresponds to the before-tax equivalent yield of a fully tax-exempt EE bond [4%/(1.–.28)]. Since the EE bonds have no reinvestment rate risk, we compare their yield to Treasury strip yields.

As of August 16, 1993, the term structures cross at seven years. Consider a middle-income family (i.e., who are in the 28% federal tax bracket and for whom the EE interest will be fully exempt) with a child entering college in five years. The figure implies that this family should prefer EE bonds yielding 4% after taxes to a Treasury strip yielding 5.12% before taxes and 3.69% after taxes [5.12%/(1–.28)].

C. Retirement Planning

Investments in EE savings bonds can be used to defer interest income until retirement. An individual could purchase EE bonds during his or her working years and defer the recognition of the interest until his/her retirement years. This retirement planning strategy may prove even more beneficial for an individual who works in a high income-tax state and plans to retire in a low income-tax state.

As with other tax-deferred retirement strategies, major advantages include not only the possibility of a lower tax bracket after retirement but also the greater accumulation of wealth since there is no loss of investment return due to income tax payments.

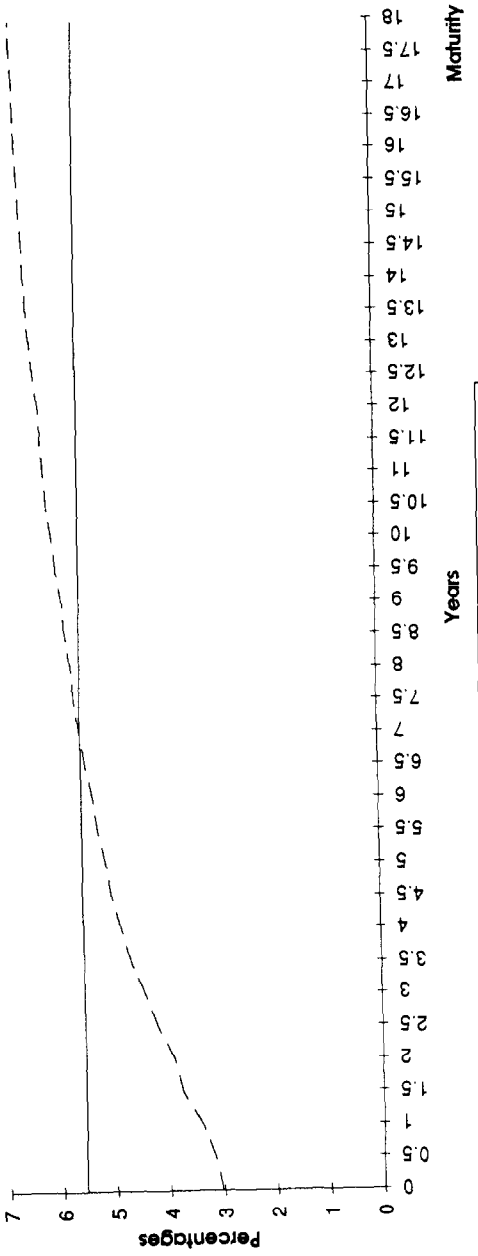

Figure 3. Term structures of treasury strips and EE bonds

During retirement, the investor can choose either to keep the EE savings bond and allow the interest to accumulate or to exchange EE bonds for interest-paying HH bonds. The latter strategy will probably be preferred if the individual depends on the interest payments to meet his/her income needs. As mentioned before, the tax-deferred interest on EE bonds that is rolled into HH bonds is not taxable until the HH bond is redeemed or matures.

VI. SUMMARY

U.S. savings bonds are complex contracts. Financial planners have traditionally paid little attention to savings bonds, in part because they often offer below-market interest rates. However, savings bonds sometimes offer above-market interest rates. By early 1993, many financial planners recognized the above-market yields offered on 6% EE savings bonds. The rush to capture these attractive yields forced the Treasury to lower the promised interest rate on new funds invested in EE bonds to 4%. We suspect that few planners recognized that the 4% EE savings bonds offered above-market yields through March 1994 when viewed as a substitute for money market investments. In this article, we have tried to demonstrate how savings bonds can be analyzed for investors with short-term to long-term investment horizons. Our approach should help planners identify unique investment opportunities.

HH-series and EE-series savings bonds contain put options that protect the investor against a rise in interest rates. The EE bonds also offer several tax options. We have shown how savings bonds can be used to beat the kiddie tax, to finance postsecondary education, and in retirement planning. With a little imagination, an astute planner could think of other uses.

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NOTES

1. Interest on marketable Treasury securities accrues daily. On a 4% coupon bond, interest accrues at \$0.1096 per day (\$40/365). An investor who sells a marketable bond 10 days after the last coupon payment date would receive \$1.10 accrued interest. In contrast, the investor in an HH savings bond gets no interest unless it is held for the full six months. On EE bonds, interest accrues (i.e., redemption value rises) monthly after six months.

2. In a financial calculator, insert FV = \$1 par value, PMT = \$.03 per six-month period, n = 8 six-month periods, and i = 5.31%/2 = 2.655%.

3. Brennan and Schwartz (1977) make the same point. "[The lack of marketability] presents no obstacle to the investor in an efficient capital market since the bond can be priced and the optimal exercise strategy determined even if trading of the bond is not allowed" (p. 68).

Even though the HH bond cannot be sold at a premium above par, the present value of its cash flows exceeds par. Its value **when held as an investment** exceeds par. Instead of holding the bond, suppose the individual wants to reduce his/her portfolio's exposure to government securities and invest in common stocks. In this case, the HH bonds could be held (you do not liquidate an asset worth 102.46 for 100) and some other similar-risk asset liquidated to finance the increase in common stock. The lack of a secondary market would impact the utility of a savings bond only when (1) the individual wanted to change the composition of the portfolio and (2) there were no other marketable securities

of comparable risk to the savings bonds that can be liquidated. In practice, we believe this would be a minor problem.

4. The $1 bond pays $1.02 in six months. The six-month Treasury bill discount yield of 3.11% implies a present value of $1.02 (.98428), where: [.98428 = 1 – .0311 (182/360)].

5. The *Wall Street Journal* reports an average three-month CD rate of 2.68%. Since the six-month yield on Treasury bills is only 13 basis points above the three-month yield, the 3% estimate for the six-month CD rate appears generous.

6. With a savings bond, an investor receives credit for the full month even if the funds are registered on the last day of the month. Thus, the 2% return can be earned in five months and two days. An EE bond registered on January 31 can be redeemed in 152 days on July 1. The annualized return is 4.74%, [2%*(360/152)].

7. The one-year yield on coupon-bearing Treasuries is 3.39. On a financial calculator, insert $n = 2$, $i = 3.39\%/2 = 1.695\%$, $PMT = \$.02$, $FV = \$1$.

8. The average of bid and ask prices for February 1994 and August 1994 Treasury strips are 98:15 and 96:22.5, where the latter denotes 96 plus 22.5/32% of par. The implied yield is [(98:15/96:22.5) – 1]. The implied forward price is 96:22.5/98:15, or $.9821.

9. On a financial calculator, insert $n = 5$, $i = 2.205\%$, $PMT = \$0.02$, $FV = \$1$.

10. The interest on qualifying bonds will be excluded from federal income tax only if the qualifying tuition and fees paid during the year are equal to or more than the redemption proceeds (interest and principal) of qualified bonds, regardless of how the bond proceeds are actually used. If tuition and fees are less than the value of the bonds cashed, the exclusion is proportional to the percentage of the value that was used for tuition and fees. For example, if a bondholder redeemed $10,000 worth of bonds during the year but tuition and fees totaled only $8,000, 80% of the interest income could be excluded from federal income tax. To avoid this problem, parents should buy several small-denomination EE bonds instead of one large-denomination bond. For example, the parents could buy 20 bonds worth $500 each instead of one bond worth $10,000. They could then liquidate an amount to ensure that the interest was fully tax exempt.

REFERENCE

Brennan, M.J., & Schwartz, E.S. (1977). Savings bonds, retractable bonds, and callable bonds. *Journal of Financial Economics*, 67–88.