CHANGING YIELD SPREADS IN THE U. S. GOVERNMENT BOND MARKET[1]

FLOWER BONDS BLOOM, THEN WILT

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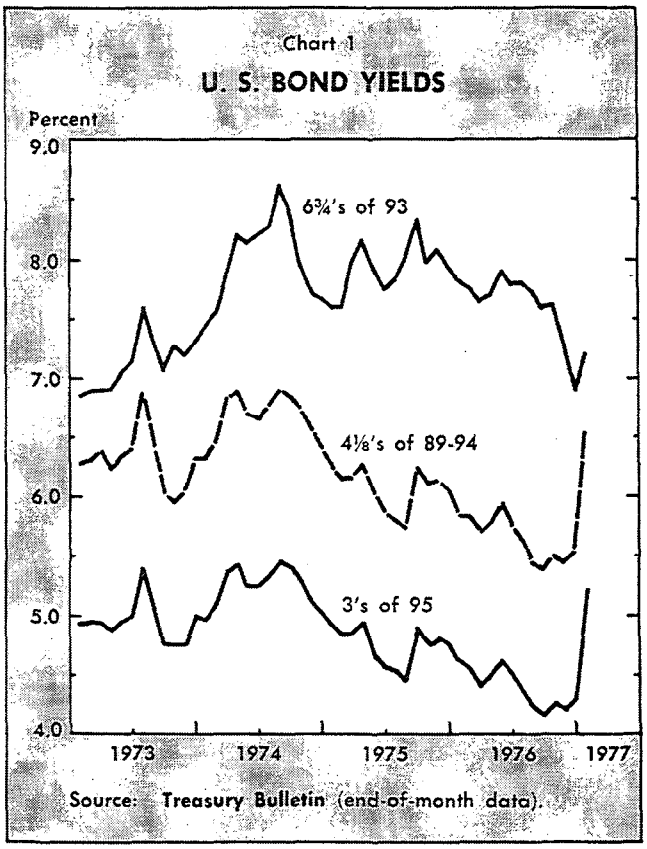
The differentials, or spreads, among the yields of individual U. S. government bond issues vary significantly over time. This variability was particularly noticeable in the last two months of 1976 and the first month of 1977. The rapidly changing configuration of U. S. bond yields over this period is largely attributable to changes in the tax code implemented by the Tax Reform Act of 1976. This article specifies the determinants of U. S. bond yield spreads. In particular, these spreads are explained by two factors, referred to in the article as the "capital gains effect" and the "flower bond effect." The first effect occurs because some U. S. bonds carry coupons well below market yields, while the second effect occurs because some U. S. bonds have a special feature enabling them to be used at par value for estate tax purposes.

The article proceeds as follows. First, it provides a framework for analyzing how the capital gains and flower bond effects contribute to U. S. bond yield spreads. Then it reviews the impact of these effects on U. S. yield spreads from the mid-1960's to the passage of the Tax Reform Act, attempting for the latter part of this period to decompose selected spreads into parts attributable to the two effects. Lastly, it discusses the impact of the 1976 Tax Reform Act on U. S. bond yield spreads.

Factors Contributing to U. S. Bond Yield Spreads

As of the beginning of this year, there were 15 outstanding U. S. bond issues maturing or callable in 10 years or more. Six of these issues were sold prior to June 1963 and have coupons ranging from 3 to 4¼ percent. The other nine were issued after January 1973 and have coupons ranging from 6¾ to 8½ percent. This article focuses on a representative sample of these issues, namely the 3's of 95, the 4⅛'s of 89-94, and the 6¾'s of 93. (The first number refers to the coupon of the bond and the second refers to the call date, if there is one, and maturity date.) Chart 1 shows the movement in the market yields of these three bonds since January 1973, when the 6¾'s of 93 were first issued. Not only are there significant differences among the yield levels, but the spreads between them vary substantially.

Intuitively, it appears paradoxical that investors would allow yield differentials to persist on bonds of equal quality and roughly equal maturity, such as those shown in Chart 1. The explanation, however,



[1] This article is adapted from a section of [2].

is straightforward. Virtually all calculated yield series are *before-tax* yield series generally computed under the assumption that the bond is *held to maturity*.[2] In this framework the yield is the discount rate r that equates the bond's price P to the present value of the future cash flows associated with holding it. If a bond with a par value of $100 pays a constant return C each year and matures in N years, then the yield is determined by the formula

$$(1)\quad P = \sum_{n=1}^{N} \frac{C}{(1+r)^n} + \frac{100}{(1+r)^N}$$

The formula has two aspects that contribute to spreads between U. S. bond yields. First, it calculates a before-tax yield when in fact the relevant yield to an investor is, abstracting from risk considerations, the after-tax yield that equates the price of a bond to the present value of the future after-tax returns. Income accruing to long-term bonds is alternatively subject to the relevant marginal income tax rate, to the capital gains tax rate, or in some cases, to no tax rate. Consequently, a wide range of before-tax yields can provide the same after-tax yield.

The price of a bond that is "seasoned" (i.e., old or outstanding) will deviate from its par value in order to keep the yield in line with current market yields. In particular, a bond with a coupon below current market yields will sell at a discount (price below par) in order to raise the yield to a level equivalent to that of comparable newly-issued bonds. For such a discount bond, the after-tax yield r* is determined by the formula

$$(2)\quad P = \sum_{n=1}^{N} \frac{C(1-t)}{(1+r^*)^n} + \frac{(100-P)(1-cg)}{(1+r^*)^N} + \frac{P}{(1+r^*)^N}$$

where t is the marginal income tax bracket of the investor, and cg is the tax rate on long-term capital gains.[3] The interest income C is taxed at the relevant personal income or corporate income tax rate, while the capital gain at maturity ($100—P) is taxed at the lower capital gains tax rate.

A low coupon seasoned U. S. bond selling at a discount will require a lower before-tax yield than a new issue bond for two reasons. First, the tax rate applied to the long-term capital gain at maturity of the discount bond is below the marginal tax rate. Second, a larger part of the tax is deferred to a later period. For given marginal and capital gains tax rates, any number of combinations of coupons and before-tax yields as calculated by formula 1 will provide the same after-tax yield as calculated by formula 2.

The second aspect of formula 1 that contributes to spreads among U. S. government bond yields is the assumption that the bond is held to maturity. This assumption may not hold for an important class of bonds, namely those that are redeemable at *par value* for estate tax purposes regardless of their market value. These bonds are often purchased with the expectation that they will be retired well before maturity. If such a bond is purchased at a discount, the expected yield rises as the expected holding period declines, because the capital gain when the bond is retired is spread over a shorter period of time.

U. S. bonds redeemable at par for estate tax purposes are widely and irreverently called "flower" bonds because of the association between flowers and funerals. In addition to their par value redeemability, these bonds had a second notable feature prior to the 1976 Tax Reform Act. Under then-existing tax law, beneficiaries computed the gain or loss on inherited property on the basis of the fair market value of the property on the date of the decedent's death. In the case of flower bonds, this value was the par value of the bond. Consequently, no capital gains tax had to be paid on the difference between the purchase price and the par value of the bond. (The capital gain was not completely tax free, however, since it became part of the decedent's estate and was, therefore, subject to estate taxation.) In summary, prior to the recent changes in the tax code, flower bonds used for estate tax purposes had two features that lowered their before-tax yield-to-maturity as calculated by formula 1. First, they provided relatively tax-free capital gains. And second, *because* they were discount bonds, their relatively short expected holding period raised their expected yield.

For completeness, it should be noted that a third factor, length of time to maturity, can also contribute to differentials between U. S. government bond yields. This factor is relatively unimportant, however, for bonds that have a maturity of 15 years or longer, such as those considered in this article; therefore it is ignored.

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[2] The effects on observed yield differentials of call provisions, default risk, and tax treatment are discussed in the context of the yield-to-maturity formula in [1].

[3] The formula is more complicated for a bond selling at a price greater than its par value because the investor has the option of accepting a capital loss at maturity or annually taking part of the premium paid for the bond as a deduction against current interest income.

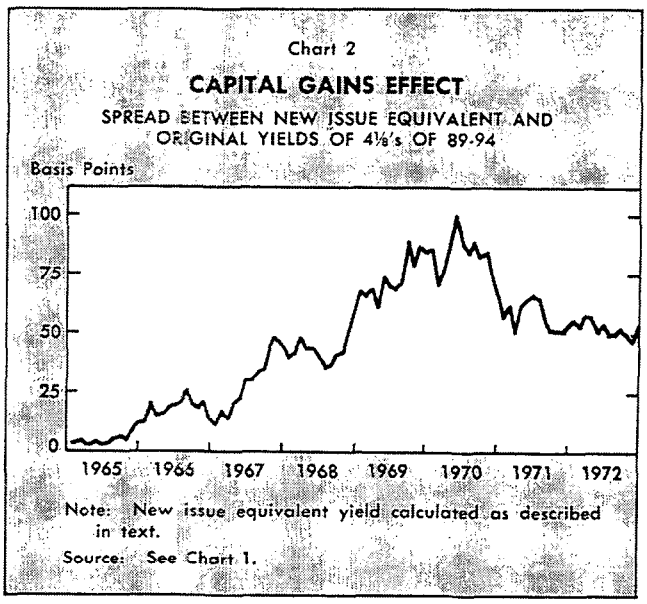
U. S. Bond Yield Relationships Prior to 1973 In the latter half of the 1960's and the early 1970's, virtually all long-term U. S. government bonds had two characteristics that affected their relative yields. First, they carried coupons below current market yields and, as a result, sold at prices below their par values. This occurred because as yields in the mid-1960's rose above the Congressionally-legislated 4¼ percent interest rate ceiling on new Treasury bonds, the Treasury was unable to sell new issues. When market yields continued to rise in the late 1960's, the discount on outstanding U. S. bonds became progressively larger.

Because they were selling at a discount, the before-tax yields on these low coupon U. S. bonds were depressed relative to the yields on new issues of taxable bonds in other sectors. An approximate measure of the impact of a low coupon on a bond's before-tax yield can be derived by using its before-tax yield series to construct a "new issue equivalent" yield series that, given marginal and capital gains tax rate assumptions, would provide the same after-tax yield. Specifically, the after-tax yield-to-maturity for any discount bond can be calculated from formula 2 after making marginal and capital gains tax rate assumptions and using the appropriate coupon and maturity. The after-tax yield can then be converted into its corresponding new issue equivalent by the formula

$$\text{new issue equivalent yield} = \text{after-tax yield}/(1-t).$$

The effect of the low coupon on the observed yield series is then calculated as the spread between the reconstructed new issue equivalent and the original yield series for the low coupon bond. This spread is a measure of the capital gains effect on the low coupon bond yield.[4]

Chart 2 shows the spread between the new issue equivalent and original yield series for the 4⅛'s of 89-94. Corporate marginal and capital gains tax rates applicable in each period were used to construct the new issue equivalent yield series.[5] The spread between the new issue equivalent and original yield series rises and falls with the level of interest rates



since the higher the interest rate level, the greater the discount for a bond with a fixed low coupon and, hence, the greater the capital gain at maturity. The spread reached a peak of 100 basis points in May of 1970. Consequently, given the tax rate assumptions, the capital gains tax effect was responsible for 100 basis points of the rise in the spread between the observed yields on newly-issued bonds and the yield on the 4⅛ percent coupon U. S. bond over this period.[6]

The second characteristic of U. S. bonds affecting their before-tax yields over this period was that virtually all of them could be used for estate tax purposes. Of these, the ones actually purchased because of this feature tended to be the lowest coupon bonds, such as the 3's of 95 and the 3½'s of 98, which were selling at the largest discounts. Evidence of this is seen in the table, which shows the amount of six flower bond issues outstanding at the end of each year from 1965 through 1976. The net decline from year to year is a measure of the amount used for estate tax purposes. The amount outstanding of the 3's of 95 declined steadily throughout the period, and the amount outstanding of the 3½'s of 98 declined steadily beginning in the late 1960's. There was no decline in the amount outstanding of the 4¼'s of 87-92, the 4⅛'s of 89-94, and the 4's of 88-93 until 1971, however, and the decline was extremely small until 1973.

[4] It should be emphasized that this procedure is valid only over a period when the low coupon bond's yield is unaffected by the flower bond provision. If the flower bond provision is pulling down the low coupon bond's yield, thereby decreasing the differential between its yield and coupon, the estimate of the capital gains effect calculated in the manner described here will be biased downward.

[5] It is argued in [2] that the corporate tax rates are appropriate rates to use to calculate new issue equivalent yields for low coupon U. S. bonds and that other reasonable assumptions result in new issue equivalent yield series that are not very different from those derived using corporate tax rates. [3] concludes that the best tax rate assumptions to use in adjusting the yields on low coupon discount bonds are slightly lower than the corporate tax rates.

[6] In actuality, the spread between new issue prime corporate rates and the market yield of the 4⅛'s of 89-94 rose by more than 200 basis points through mid-1970. It is argued in [2], however, that other factors such as differential call risk and default risk can explain the additional rise in the spread.

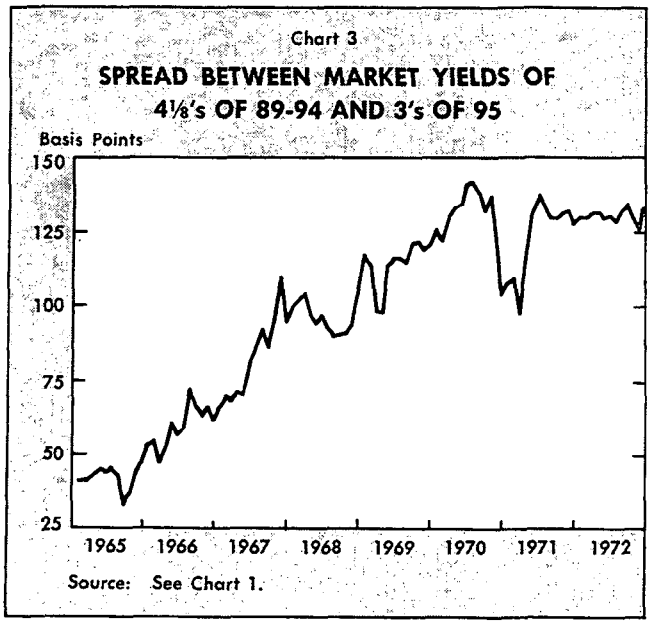


Chart 3 shows the spread between the market yields of the 4⅛'s of 89-94 and the 3's of 95. The spread widened considerably in the latter half of the 1960's. Part of the rise can be attributed to the greater capital gains effect on the yield of the lower coupon 3's of 95. Most of the rise, however, occurred because the flower bond provision had a much greater depressing influence on the yield of the 3's of 95 than on the yield of the 4⅛'s of 89-94. In fact, the argument can reasonably be made on two grounds that the yield of the 4⅛'s of 89-94 (and similar coupon bonds) was affected very little by the flower bond provision over this period. First, the evidence on outstanding flower bonds in the table indicates that there was relatively little demand for the 4⅛'s of 89-94 (and similar coupon bonds) related to their flower bond provision through the early 1970's. Second, when new high coupon bonds (6¾ percent or higher) were issued again in the 1970's, the differentials between their yields and the yield of the 4⅛'s of 89-94 could initially be fairly well explained by the capital gains effect alone.

U. S. Bond Yield Spreads From 1973 Through Late 1976 In the early 1970's two developments occurred that were to affect significantly the spreads among U. S. government bond yields. First, the 4¼ percent ceiling on new U. S. bond issues was lifted to permit the issue of some high coupon bonds at current yields. Second, effective March 1971, Congress eliminated the extension of flower bond privileges on new U. S. bond issues, thereby insuring a steadily declining stock as outstanding issues purchased for estate tax purposes were retired over time. The table shows the decline in the stock of flower bonds in recent years.

The presence of newly-issued high coupon U. S. bonds in the 1970's makes it possible to get a more precise measure of the impact of the flower bond provision on low coupon U. S. bond yields by decomposing the spread between the yields of a high coupon bond and a seasoned low coupon bond into the part attributable to the capital gains effect and the part attributable to the flower bond provision of the low coupon bond. The capital gains effect can be calculated as follows. First, the after-tax yield of a high coupon bond is calculated using formula 2. Second, using formulas 1 and 2, the before-tax yield for a specific low coupon bond is constructed that provides the *same* after-tax yield as the high coupon bond.

AMOUNT OF FLOWER BONDS OUTSTANDING

($ millions)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
3½'s of 90	4900	4894	4885	4873	4819	4727	4537	4262	4018	3750	3545	3086
4¼'s of 87-92	3818	3817	3817	3816	3814	3809	3794	3765	3695	3605	3490	3028
4's of 88-93	250	250	249	249	249	248	245	240	230	224	220	191
4⅛'s of 89-94	1560	1560	1559	1559	1558	1554	1543	1514	1470	1384	1312	1146
3's of 95	2207	2006	1801	1610	1408	1253	1108	959	851	757	692	626
3½'s of 98	4413	4395	4367	4307	4207	3999	3706	3365	3132	2901	2652	2261
TOTAL	17148	16922	16678	16414	16055	15590	14933	14105	13396	12621	11911	10338

Note: End-of-year data for all flower bonds with a maturity of 1990 or later.

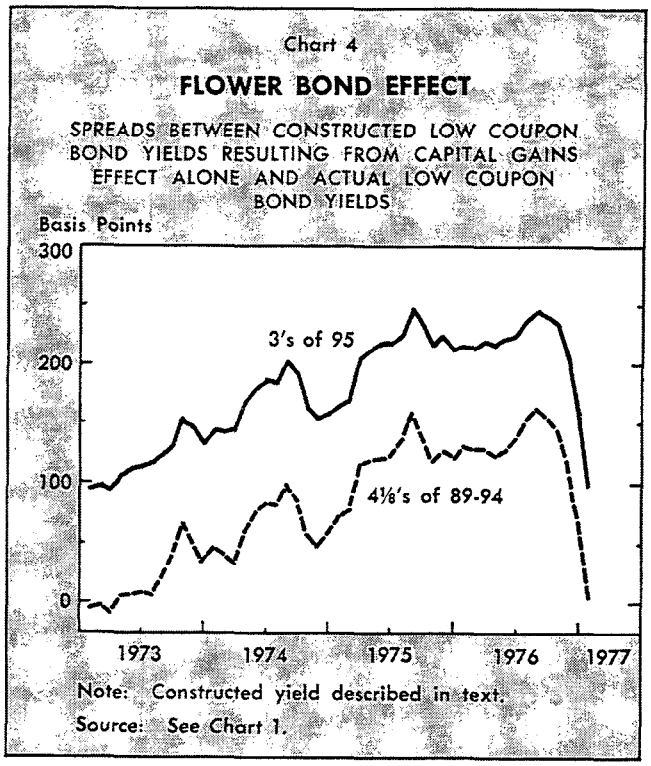
Source: Treasury Bulletin.

Third, the differential between the high coupon bond before-tax yield and the constructed low coupon bond before-tax yield is calculated. This differential is the capital gains effect on the spread between the high and low coupon bond yields; it is solely attributable to the difference in coupons of the two bonds. If the low coupon bond's flower bond provision is causing additional downward pressure on the low coupon bond's yield, this yield will fall below the constructed yield that provides the same after-tax yield as the high coupon bond. The difference between the constructed yield and the actual low coupon bond yield can, therefore, be attributed to the flower bond provision and used as a measure of the flower bond effect on the low coupon bond's yield.

Using the 6¾'s of 93 as the high coupon bond, Chart 4 shows the flower bond effect on the yields of the 3's of 95 and the 4⅛'s of 89-94. The chart shows an increase in the flower bond effect that begins in 1973 and subsequently rises sharply. This trend is similar both for the bonds whose yields had already been substantially affected by the flower bond effect, such as the 3's of 95 and the 3½'s of 98, but also for those, such as the 4⅛'s of 89-94 and the 4¼'s of 87-92, whose yields had previously been affected only slightly. According to the estimates in the chart, the flower bond effect on the observed yield of the 3's of 95 rose from 100 basis points in mid-1973 to 250 basis points in September 1976. Over the same period the flower bond effect on the yield of the 4⅛'s of 89-94 went from nil to 160 basis points.

Two factors account for the sharp increase in the impact of the flower bond effect on low-coupon, deep-discount bond yields over this period. First, the stock of flower bonds was steadily declining, and it was widely and correctly expected that there would be no additions to the supply in the future. This circumstance alone would be expected to lead to ever-higher premiums on flower bonds. It was reinforced, however, by rapid rates of inflation, which drove up the value of estates. Since tax laws were not changed to adjust for the impact of inflation on the level of estate taxes, the demand for flower bonds naturally increased. The combination of decreasing supply and increasing demand resulted in a continually increasing flower bond effect on the yields of low coupon U. S. bonds through the third quarter of 1976.

U. S. Bond Yield Spreads Since Passage of the 1976 Tax Reform Act The Tax Reform Act of 1976, passed in October, has had a significant effect



on U. S. government bond yield spreads through its impact on the demand for flower bonds. The Tax Reform Act did not explicitly deal with flower bonds. Thus, bonds that were redeemable at par for estate tax purposes retain that feature. Nevertheless, the Act contained a provision that diminished the appeal of flower bonds. As indicated earlier, prior to the 1976 Act flower bonds, like other investments providing capital gains, were valued as inherited property at their fair market value on the date of the decedent's death; for flower bonds this value was the par value of the bond. Consequently, under the old tax law not only was there the potential of a very rapid capital gain, but it was free from capital gains tax.

The 1976 Tax Act changed the tax basis for inherited property to its cost to the decedent. For certain property, such as flower bonds, beneficiaries may increase the cost basis to the fair market value of the property on December 31, 1976. Consequently, under the new law the difference between the par value of the flower bond used for estate tax purposes and the original cost or market value at the end of 1976, whichever is greater, is subject to capital gains taxation. The extent of the capital gains tax is a complicated matter depending on the individual's estate tax.

A second provision of the Tax Act that has possibly decreased the attractiveness of flower bonds is

the extension from six months to one year (by 1978) of the holding period necessary to apply the long-term capital gains tax rate. It is not yet clear how this will affect "deathbed" purchases of flower bonds which were a common but somewhat controversial matter even under the old tax law.

The flower bond effect on U. S. bond yield spreads diminished greatly following passage of the 1976 Tax Reform Act. As Chart 4 indicates, the flower bond effect on the low coupon yields began to decline around the time of the passage of the Act. The decline in the flower bond effect on the low coupon U. S. yields became more rapid in November and December and accelerated further in January. Interestingly, the changing flower bond effect prior to January was not widely recognized because market yields were falling. Thus, yields on low coupon flower bonds were relatively stable over this period while yields on high coupon U. S. bonds were falling sharply. It was only in January, when increases in the yields on high coupon U. S. bonds were far outpaced by increases in the yields on low coupon bonds, that the impact of the 1976 Tax Reform Act on flower bond yields was widely recognized.

From October 1976 through January 1977 the typical decline in the flower bond effect on low coupon bond yields was about 150 basis points. For the 4⅛'s of 89-94 (and similar coupon bonds, such as the 4¼'s of 87-92 and the 4's of 88-93) the flower bond effect was almost wiped out. That is, as of the end of January the spreads between the original before-tax yields of these issues and the yields of high coupon U. S. bonds could be almost completely explained by the capital gains effect. For the lowest coupon bonds, such as the 3's of 95 and the 3½'s of 98, the flower bond effect as of the end of January still accounted for about 100 basis points of the differential between the before-tax yields on these bonds and the yield on high coupon bonds.

It should be noted in conclusion that the capital gains effect and the flower bond effect on before-tax U. S. bond yields are of interest not only to investors but also to researchers who use before-tax U. S. bond yield series in studies of risk, studies of interest rate expectations, and studies of the impact of relative supplies of debt on yield differentials. These yield series are frequently used with the implicit assumption that investors respond to before-tax, rather than after-tax, yields. Their use, without proper regard for the impact of the capital gains and flower bond effects on before-tax yield relationships, can be highly misleading.[7]

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[7] [2] discusses several studies that have used U. S. government bond yield series without regard for the possible impact of the capital gains and flower bond effects on the movement of the series.

References

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