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Some Factors Affecting Long-term Yield Spreads in Recent Years

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Introduction The past decade has been a period of unprecedented movement in interest rates. Chart 1 shows the movement over this period in five commonly cited interest rates series. Two observations can be made from Chart 1 about the behavior of the interest rate series in the period shown. The first is that the rates generally move in the same direction over time. All five of the series shown rose greatly in the late 1960's, and all reached a peak in the first half of 1970. The second observation is that the differentials among the interest rate series changed substantially over the 10-year period. This observation is true not only for long-term rates relative to the short-term rate, but it is also true of the long-term rates relative to each other. To take one example, at the beginning of the period in February 1964, the corporate bond rate was only 25 basis points higher than the long-term United States government bond rate. The differential or spread between the two rates rose to 135 basis points in September 1966, fell to 88 basis points in February 1967, increased to 273 basis points in November 1970, and fell to 153 basis points in February 1973.

The lack of stability that characterizes the spread between the corporate bond and U. S. government bond interest rate series extends to the other interest rates as well, as shown in Table I, where all four of the other rates are compared to the corporate bond rate. The spreads between the corporate bond rate and the other rates varied 180 basis points or more in all four cases. In the most extreme case, the spread between the corporate bond rate and the short-term Treasury bill rate moved from a low of 24 basis points in January 1966 to a high of 401 basis points in March 1971.

Table I

INTEREST RATE SPREADS

1964-73

	High	Date	Low	Date
Corporate Bond Rate Minus U.S. Bond Rate	2.73	Nov. 1970	.25	Feb. 1964
Corporate Bond Rate Minus Treasury Bill Rate	4.01	March 1971	.24	Jan. 1966
Corporate Bond Rate Minus Mortgage Rate	1.15	June 1970	—1.41	Feb. 1964
Corporate Bond Rate Minus State and Local Bond Rate	3.08	Aug. 1970	1.28	Jan. 1966

This characterization of interest rate movement differs substantially from the standard macroeconomic textbook treatment in which "the" interest rate is determined by an appropriately specified model. If the relationships among the interest rates were fairly constant over time—that is, if interest rate spreads displayed little variation—then it would be of little concern that there are many interest rates, since an appropriate explanation of the movement in any one of the interest rates would suffice as an explanation for the movement in all other rates. Unfortunately, as shown in Chart 1, the relationships among the various levels show substantial variation over time, particularly in a period of large interest rate movements, such as the late 1960's.

Security characteristics The size and variability of spreads among interest rates raise two important questions. First, of what concern is it that the spreads vary substantially over time? Second, what causes this variation? The answer to the first question is related to the fact that securities are issued to finance a variety of activities. In particular, different long-term securities are issued to finance different types of real investment. State and local bonds finance state and local construction, home mortgages finance residential construction, corporate bonds primarily finance the construction of plant and equipment, and long-term U. S. bonds finance part of the Federal deficit. When an interest rate series for one of these securities rises relative to the interest rate series for another of the securities, the cost of the activity the former finances becomes relatively more expensive, at least at first glance. To the extent that the various economic sectors respond to changing interest rates when making decisions on real investment activity, a rise in one interest rate relative to another can thereby affect the pattern of capital allocation in the economy. Therefore, a change in a particular spread is a matter of concern not only for the sectors supplying the securities but also for policymakers whose decisions can influence interest rate relationships.

The second question—what causes movement in the spreads—is extremely complex.[1] The five interest rate series shown in Chart 1 represent only a small fraction of the total number of available interest rate series. Salomon Brothers' invaluable publication, *An Analytical Record of Yields and Yield Spreads,* alone contains 111 different interest rate or yield series, which implies the existence of literally thousands of spreads.[2] These yield series can best be classified according to the characteristics of the security or securities they represent. For the purposes of this article, these characteristics will be classified into three groups.

The first relevant characteristic of the security is the length of its term to maturity. The *Federal Reserve Bulletin,* for example, provides yield series for U. S. government securities maturing in three months, six months, one year, three to five years, and over ten years. The spread between any pair of these series changes dramatically over time, as can be seen in Chart 1.

Securities can also be characterized by the particular sectors of the economy that issue and purchase them. Underlying the supply of and demand for securities by these sectors is a whole set of factors, sometimes called "fundamental" influences on interest rate movements. They include the savings behavior of the various sectors and the real investment expenditures of these sectors. Also included are certain policy variables of the Federal Government that influence economic activity by directly affecting security supply or demand in a particular market. Attempts to determine the effects of these factors on interest rate spreads are greatly complicated because a given factor, such as household saving, has simultaneous effects in many security markets.

The third characteristic, or group of characteristics, of a security relevant to a discussion of yield series is the special features it has with respect to the taxability, timing, and certainty of the returns associated with holding it. There are four such features that vary among securities.[3] The first is whether the interest earned on the security is subject to Federal income tax. The second is whether the security earns income in the form of capital gains (or capital losses), which are subject to lower tax rates than interest income. The third feature is whether the issuer of the security has the option of repaying the principal

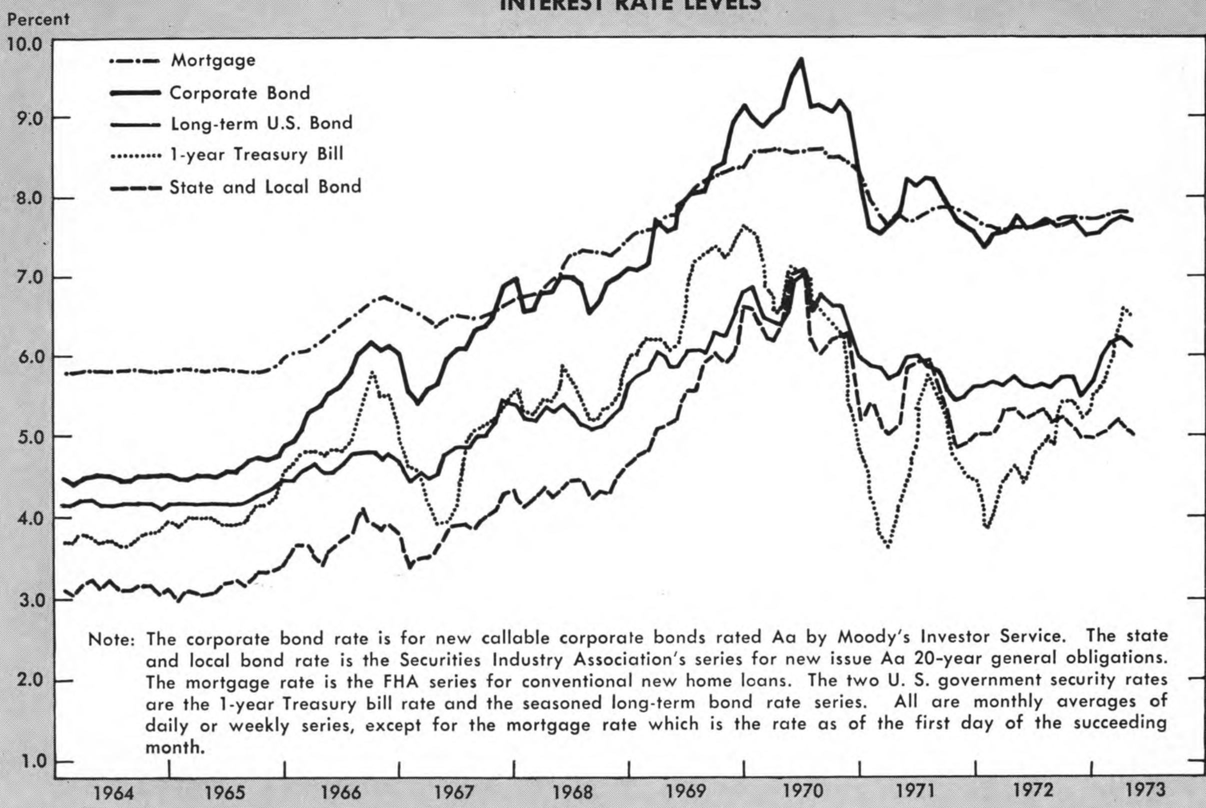
[1] For an excellent discussion of many of these causes, see James C. Van Horne, *Function and Analysis of Capital Market Rates* (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1970).

[2] The terms "interest rate" and "yield" will be used interchangeably in the remainder of the article.

[3] The feature of convertibility of a bond into a common stock is not considered, since the article is concerned exclusively with bond yield spreads.

Chart 1

INTEREST RATE LEVELS



Note: The corporate bond rate is for new callable corporate bonds rated Aa by Moody's Investor Service. The state and local bond rate is the Securities Industry Association's series for new issue Aa 20-year general obligations. The mortgage rate is the FHA series for conventional new home loans. The two U. S. government security rates are the 1-year Treasury bill rate and the seasoned long-term bond rate series. All are monthly averages of daily or weekly series, except for the mortgage rate which is the rate as of the first day of the succeeding month.

Sources: **Treasury Bulletin** and **Federal Reserve Bulletin.**

("calling" the security) at a time before it matures. And the fourth feature is the degree to which the income promised on a security is subject to uncertainty or risk of default on the part of the borrower.

Each of the three security characteristics mentioned is related to both the level and movement of interest rate spreads over time. The ideal procedure to use in attempting to explain the movement in spreads is to isolate one security characteristic at a time and study yield series for securities that are alike in all respects but that one characteristic. The problem then is to determine the factors underlying the spreads associated with that one characteristic (e.g. maturity). Unfortunately, finding interest rate series that isolate a given security characteristic is sometimes difficult, if not impossible. Nevertheless, this article will attempt to use that procedure in illustrating the effects that the four special features indicated above have had on observed yield spreads in the past ten years. The article will not attempt to explain the elements of observed yield spreads related to differences in maturity or to the behavior of the various economic sectors, but it will be argued that any attempt to explain those spreads requires an understanding of the impact on yield spreads of the special features.

Assumptions underlying the computation of yield series Observed spreads between interest rate series, such as those in Chart 1, contain an important element that results from inherent shortcomings in the formula employed in calculating yields. Spreads between yield series for securities that differ only with respect to one of the four special features discussed above are related in that they all result from these shortcomings. The yield of a security is the discount rate, r, which equates the price, P, of a security to the present value of the future cash flows associated with holding it:

$$(1) \quad P = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \ldots + \frac{C_N}{(1+r)^N} \quad ,$$

where C_i is the promised return in the ith time period.[4] In computing the yield, the assumption is usually made that the security is held to maturity, so that r becomes the "yield to maturity." For simplicity, the remainder of the article will assume that we are dealing with a bond that pays a constant return, C, each year until it matures in period N, at which time it pays the holder of the security its face value of $1000. The yield to maturity is then computed by finding the value of r that satisfies the equation:

$$(1') \quad P = \sum_{n=1}^{N} \frac{C}{(1+r)^n} + \frac{1000}{(1+r)^N} \quad .$$

[4] An explanation of this formula can be found in any introductory finance book.

On new issue securities, bonds typically sell at (or near) par, which in this case is $1000. Adjustments in yield are brought about by changes in C, the coupon. For securities that are not new, but "seasoned," P will deviate from $1000 in order to keep the yield of the security in line with current market interest rates. For example, suppose a new 20-year security is issued at a yield to maturity of 5 percent, with P = $1000 and C = $50. Five years later, the security, now seasoned, is resold when the yield to maturity on comparable new securities has risen to 7 percent. Because the $50 annual coupon on the seasoned security is lower than the $70 annual coupon on the new security, investors will only purchase the seasoned security at a reduced price. Assuming the absence of all taxes, the price of the security (where N now equals 15) would have to drop to $817 in order for the yield to maturity to equal 7 percent. The buyer of the security would realize a capital gain at the end of 15 years of $183.

There are two features of the yield formula that, when combined with the four special features, account for a large part of the variation in the yield spreads in Chart 1 and Table I. First, it should be noted that the formula computes the *before-tax* yield to maturity, when clearly the after-tax yield is the relevant consideration for the buyer of a security. Therefore, the yield formula (which is used to compute the interest rate series in Chart 1) cannot differentiate between securities that provide interest income that is or is not subject to personal and corporate income tax. Nor does it differentiate between securities that yield or do not yield a return in the form of capital gains that are taxed at a lower rate than interest income.

In the second place, implicit in the formula is the assumption that the timing and amounts of the returns associated with holding a security are known with *certainty*. Therefore, the formula cannot be used to calculate, with precision, the yield on securities that are callable, either immediately or after a deferred period. Moreover, it cannot take into account the varying degrees of certainty felt by investors that the issuer of the security will not default.

The rest of this article will look at and attempt to explain spreads among long-term interest rates arising primarily out of the failure of the yield to maturity formula to take account of the effects on computed interest rate series of income tax rates, capital gains tax rates, call provisions, and default risk.

Income tax rates and yield spreads The after-tax yield to maturity of a security for a particular investor is the discount rate, r*, which equates the price of the security to the present value of the future after-tax promised returns:

$$(2)\quad P = \sum_{n=1}^{N} \frac{C\,(1-t)}{(1+r^*)^n} + \frac{(1000-P)(1-cg)}{(1+r^*)^N} + \frac{P}{(1+r^*)^N}\,,$$

where t is the marginal income tax bracket of the investor and cg is the tax rate on long-term capital gains. The interest income, C, is taxed at the relevant personal or corporate income tax rate, while the capital gains ($1000 — P) are taxed at the capital gains tax rate. Over much of the past 10 years, cg was equal to one-half of t, up to a maximum tax of 25 percent of total capital gains.[5]

By using Formulas (1) and (2) and by specifying an income tax rate, a capital gains tax rate, a maturity date, and a coupon value, it is possible to determine, for any security, a before-tax yield that is consistent with any after-tax yield.[6] The effects of varying income tax rates, capital gains tax rates, maturities, and coupons on the relationship between before- and after-tax yields to maturity, and consequently on yield spreads, can then be isolated.

An example of this procedure is reported in Table II. The relevant marginal income tax rate is shown for values of 30 percent and 40 percent, and the capital gains tax rate is assumed to be one-half the income tax rate. The hypothetical securities are new issues sold at par. It is assumed that one security yields interest income that is tax-free, while the other yields interest income taxable at the indicated marginal tax rates. It is also assumed that investors demand equal after-tax rates. Two points, which are evident from examination of the table, are relevant to the discussion of the relationship between the yield to maturity formula and yield spreads. First, in a period of rising interest rates, spreads between yield series for securities that yield taxable interest versus those that yield tax-free interest should rise. And second, increases in income tax rates should also increase those spreads.

As is well known, interest income on state and local securities is generally tax-free. Chart 2 compares the movement of the corporate bond rate with the movement of the spread between the corporate bond rate and the state and local bond rate. Both rates are for new issues.[7] There is clear evidence that the spread rises as interest rates rise, as was predicted in Table II, although it should be clear from the preceding discussion that all the change in the spread cannot be attributed to the tax factor, since the effects of the tax factor have not been isolated from those of the other factors discussed. For the period 1966-1968, it appears that a major part of the movement in the spread can be explained by the differential tax status. In that period, the spread rose and fell with interest rate levels, keeping the relationship between the after-tax yields on the two securities relatively constant. In 1969, however, interest rates rose sharply, while the spread opened only moderately.

It should be noted that since the yield series in Chart 2 are for new securities selling at par, the equal-after-tax relationship between the state and local rate (r_{sl}) and the corporate bond rate (r_{cor}) series can be expressed simply as

$$(3)\quad r_{sl} = (1-t)r_{cor}\,.$$

Although t varies among individuals, it has been fairly constant for corporations, about 50 percent, over the period shown in Chart 2. Formula (3) can be used to determine a marginal tax rate at which investors would be indifferent in choosing between new state and local bonds and new corporate bonds of the same quality. That tax rate would be

$$(3')\quad t^* = 1 - \frac{r_{sl}}{r_{cor}}\,.$$

An investor in a marginal tax bracket greater than t* would prefer state and local bonds to corporates. The t* series is shown in Chart 3. The series averages about 32 percent over the period and never reaches 40 percent. As would be expected, these values of t* lead to a situation in which the market for state and local securities is completely dominated by financial institutions subject to corporate income tax rates—

Table II

EFFECT OF INCOME TAX ON BEFORE-TAX YIELD SPREADS

Spread Between Before-tax Yield of a New Issue Security Providing Taxable Interest Income (r_1) and Before-tax Yield of a New Issue Security Providing Non-taxable Interest Income (r_2) Assuming Equal After-tax Yields

t=40%			t=30%		
r_2	r_1	Spread	r_2	r_1	Spread
3.00	5.00	2.00	3.00	4.29	1.29
3.50	5.83	2.33	3.50	5.00	1.50
4.00	6.67	2.67	4.00	5.71	1.71
4.50	7.50	3.00	4.50	6.43	1.93
5.00	8.33	3.33	5.00	7.14	2.14
5.50	9.17	3.67	5.50	7.86	2.36
6.00	10.00	4.00	6.00	8.57	2.57

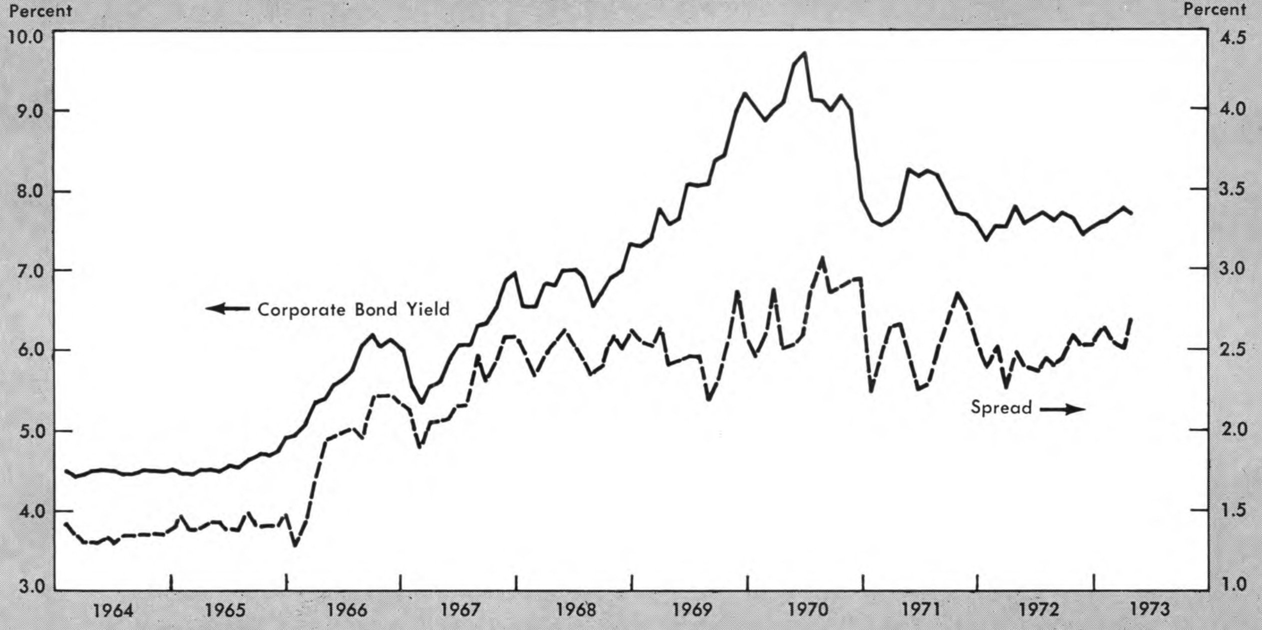
[5] The relationship of t to cg became somewhat more complex in 1970 after maximum capital gains tax rates were increased.

[6] This fact was pointed out in an article by J. W. Colin and Richard S. Bayer, "Calculation of Tax Effective Yields for Discount Instruments," *Journal of Financial and Quantitative Analysis*, 5 (June 1970), 265-73.

[7] Unless otherwise stated, the interest rate series referred to are those in Chart 1.

Chart 2

CORPORATE BOND YIELD AND SPREAD BETWEEN CORPORATE AND STATE-LOCAL YIELDS



Note: Yield series are those described in Chart 1.

commercial banks and casualty insurance companies—and by high income individuals.[8]

Capital gains tax rates and yield spreads Chart 4 compares the movement of the corporate bond yield series with the spread between the corporate bond yield series and the long-term U. S. government bond yield series. The yield series and the spread move very closely together indicating that, during the years shown, the spread increased when interest rates rose and decreased when interest rates fell. This section and the following will deal with two of the major factors causing this relationship.

The corporate bond yield series in Chart 1 is for new issue bonds selling at or near par, while the long-term U. S. government bond yield series is for seasoned bonds. There is no yield series for new issue long-term U. S. bonds since none were issued over most of the period under consideration because the maximum legal coupon was 4.25 percent until 1971. Thus, the long-term U. S. bond yield series over most of the period is for a group of securities having coupons of 4.25 percent or less. The average coupon rate on the bonds making up the yield series in June 1970, when interest rates were at their peak, was only 3.64 percent.

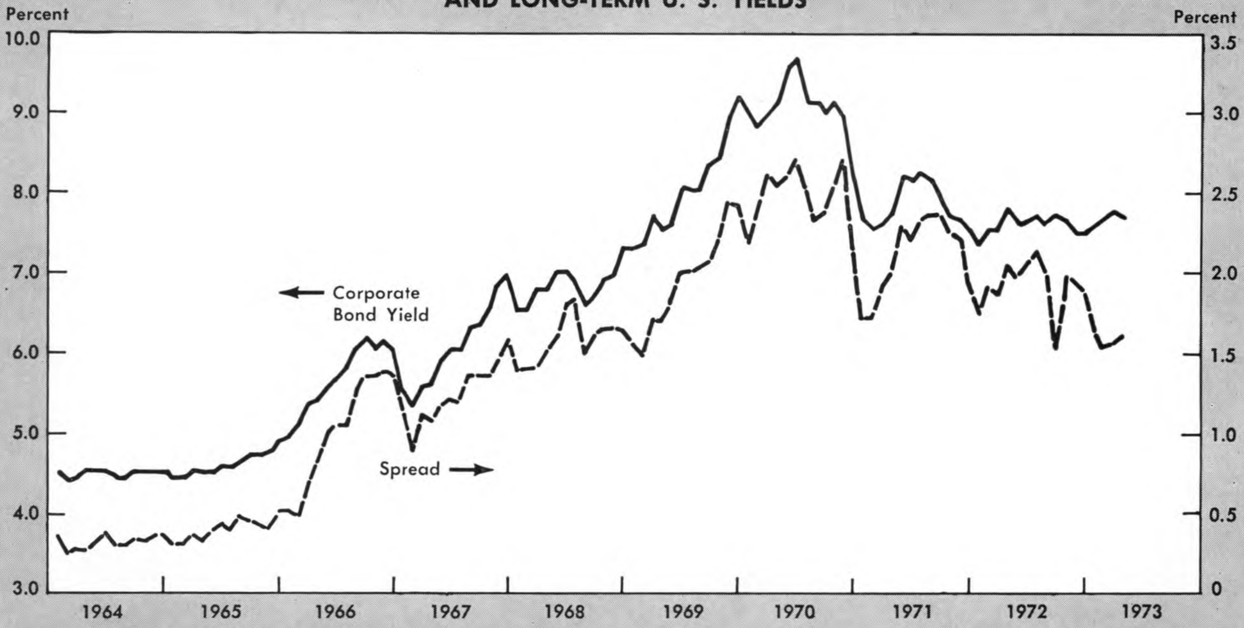
[8] Of the total $166.47 billion outstanding in state and local securities at the end of 1971, the household sector held 31.41 percent, casualty and fire insurance companies held 11.59 percent, and commercial banks held 49.78 percent. A factor contributing to the failure of the spread between the corporate and state and local bond rates in Chart 2 to rise in 1969 was undoubtedly the behavior of the commercial bank sector, which virtually withdrew from the state and local market, thereby creating upward pressure on the state and local bond rate relative to other long-term rates.

Chart 3

MARGINAL TAX RATE AT WHICH AN INVESTOR WOULD BE INDIFFERENT BETWEEN CORPORATE AND STATE-LOCAL BONDS

Chart 4

CORPORATE BOND YIELD AND SPREAD BETWEEN CORPORATE AND LONG-TERM U. S. YIELDS



Note: Yield series are those described in Chart 1.

Table III shows the spreads between the before-tax yields on a new security selling at par and a seasoned security with a \$40 coupon, for equal-after-tax yields. The income tax rate of the investor is assumed to be 40 percent, the capital gains tax rate, 20 percent, and N, 20 years. As interest rates rise, the price of the seasoned bond falls, increasing the amount of income that is received in the form of capital gains. Since capital gains are subject to a substantially lower tax rate than interest income, a lower before-tax yield on the seasoned bond is required to provide an after-tax return equal to that of the new bond. Under the assumptions made in Table III, this "capital gains" effect on the seasoned long-term U. S. bond yield series would explain almost one-half the movement of the spread in Chart 4.[9]

Table IV recomputes the spreads with a coupon of \$30, and the other assumptions unchanged. As the table indicates, the lower the coupon on the seasoned security, the greater the discount and, consequently, the greater the amount of the return of the security in the form of capital gains. This results in an increase in the spread for any specific after-tax yield.

Chart 5 compares two yield series from Salomon Brothers that are for two sets of securities which are ostensibly alike in all respects except that one is new and the other is seasoned with a 4⅛-4⅜ percent coupon. The yield series are both for deferred callable Aa public utility bonds.[10] The spread between the two yield series is similar to that indicated under the assumptions made in Table III and corroborates the capital gains tax effect on yield series between yields for new and seasoned discount bonds. Chart 5 indicates an apparent change in the relationship between the spread and interest rate levels beginning in 1970. One explanation for this change is that the Tax Reform Act of 1969 increased maximum capital gains tax rates from 25 percent to 32.5 percent for individuals and to 30 percent for corporations. Assuming an equal-after-tax yield of 4 percent and a

Table III

BEFORE-TAX YIELD SPREAD

New vs. \$40 Coupon Seasoned Security

Spread Between Before-tax Yield of New Security (r_1) and Before-tax Yield of \$40 Coupon Seasoned Security (r_2) Assuming Equal After-tax Yields (r^*)

N=20 t=40% cg=20%

r^*	r_2	P_2	r_1	P_1	Spread
2.40	4.00	\$1,000.00	4.00	\$1,000	.00
3.00	4.79	899.62	5.00	1,000	.21
4.00	6.10	760.72	6.67	1,000	.57
5.00	7.41	649.57	8.33	1,000	.92
6.00	8.73	559.62	10.00	1,000	1.27

[9] Of course, over the period, the average term to maturity of the \$40 coupon securities would decline; however, at large values of N, this would have a very small effect on the spreads in Table III.

[10] The word "ostensibly" is used because a high coupon deferred callable bond is more likely to be called than a low coupon deferred callable bond.

Table IV

BEFORE-TAX YIELD SPREAD

New vs. $30 Coupon Seasoned Security

Spread Between Before-tax Yield of a New Security (r_1) and Before-tax Yield of a $30 Coupon Seasoned Security (r_2) Assuming Equal After-tax Yields (r^*)

N=20 t=40% cg=20%

r^*	r_2	P_2	r_1	P_1	Spread
1.80	3.00	$1,000.00	3.00	$1,000	.00
2.50	3.91	875.71	4.17	1,000	.26
3.00	4.55	799.24	5.00	1,000	.45
4.00	5.83	670.98	6.67	1,000	.84
5.00	7.10	568.70	8.33	1,000	1.23
6.00	8.38	486.23	10.00	1,000	1.62

marginal income tax bracket of 50 percent, the effect of an increase in the capital gains tax from 25 percent to 30 percent would be to decrease the spread between the before-tax yields of a new security selling at par and a seasoned one bearing a $40 coupon from 114 to 104 basis points. Thus, the increase in capital gains tax rates would explain some, but apparently not all, of the change in the relationship in 1970 between the two curves shown in Chart 5.

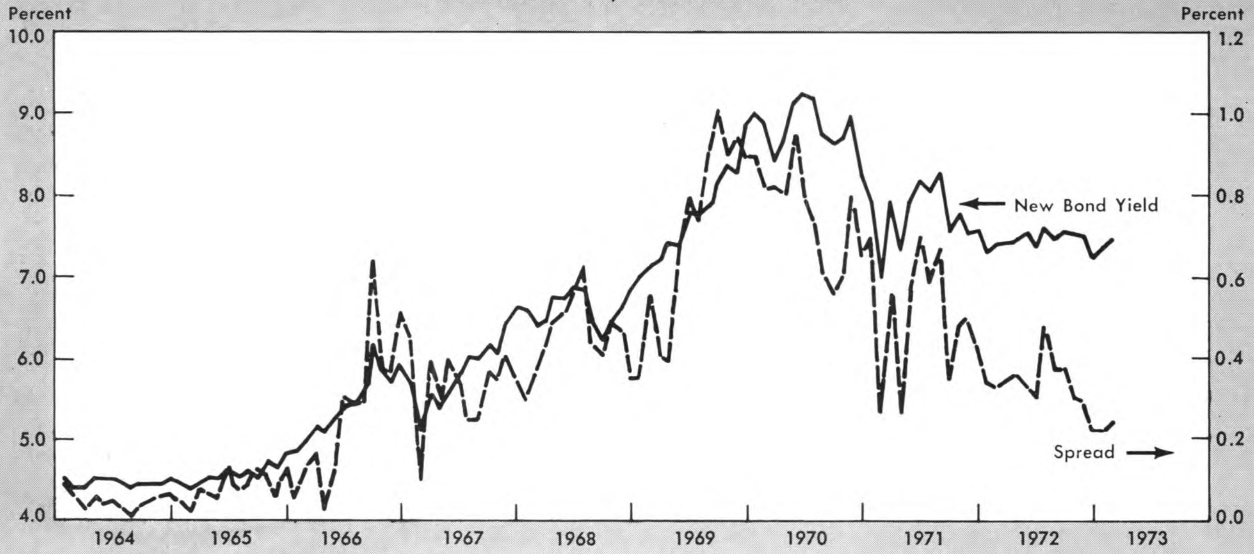
When interest rates have fallen from past levels, seasoned securities with coupons higher than prevailing market interest rates will sell at a premium (P > $1000) and, consequently, will yield a capital loss at maturity. Under these circumstances, investors would be expected to demand a higher before-tax yield to maturity on the seasoned bond. Chart 6 demonstrates this effect by comparing the yield of the Aa deferred callable, new, utility bond yield series with the spread between it and the yield series for a similar bond that differs only in that it is seasoned with an 8-8⅜ percent coupon. The chart clearly indicates that when market rates fell below the coupon (8 percent), the observed yield on the seasoned bond became larger than the new issue bond yield. Table V shows the before-tax yields on a hypothetical premium seasoned bond with an $80 coupon necessary to give after-tax yields equal to those on new issues in a period when interest rates are below 8 percent. The results are similar to the actual spread in Chart 6.

Recently, new long-term U. S. bonds at current coupons have been issued. At the present time, three of the ten bonds in the sample used to compute the long-term U. S. bond series are high coupon (over 6 percent) bonds. The presence of the high coupon bonds in the sample should affect the relationship between the U. S. government bond yield series and the other series. Chart 4 provides some support for this expectation in that it appears that in 1973 the spread between the corporate and U. S. bond rates is smaller than it has been at similar interest rate levels in the past.

Call provisions and yield spreads A third element entering into observed yield spreads results from the inability of the yield to maturity formula to account for differences in call provisions. Call provisions give the issuer of the security the option of prepaying the face value before the stated time of maturity.

Chart 5

NEW BOND YIELD AND SPREAD BETWEEN NEW AND 4⅛-4⅜ COUPON, SEASONED YIELDS



Note: Yield series are for Aa deferred callable utility bonds.

Source: Salomon Brothers, *An Analytical Record of Yields and Yield Spreads.*

Table V

BEFORE-TAX YIELD SPREAD

New vs. $80 Coupon Seasoned Security

Spread Between Before-tax Yield of a New Security (r_1) and Before-tax Yield of An $80 Coupon Seasoned Security (r_2) Assuming Equal After-tax Yields (r^*) and No Tax Break On Capital Losses[11] N=20 t=40%

r^*	r_2	P_2	r_1	P_1	Spread
4.80	8.00	$1,000.00	8.00	$1,000	.00
4.50	7.61	1,039.02	7.50	1,000	−.11
4.00	6.98	1,108.72	6.67	1,000	−.31
3.50	6.35	1,184.76	5.83	1,000	−.52
3.00	5.72	1,267.79	5.00	1,000	−.72

Virtually all corporate bonds and mortgages have some kind of call provision, while state and local bonds do not. Some U. S. government bonds are callable, but the long-term U. S. bond yield series shown in Chart 1 excludes bonds callable in less than 10 years. Call provisions for corporate bonds for which yield series are available specify that the bond is callable either immediately or after a deferred period of five years. Typically, if the bond is called, a penalty is paid by the issuer, which varies directly with the remaining years to maturity. A common penalty for a corporate bond called after five years would be one year's coupon.

Yields on bonds with call features are calculated, like yields on bonds without call features, by the yield to maturity formula (1). The resulting effects on observed yield spreads can be seen by considering the case of an investor with money to invest for N years who buys a N-year bond subject to call anytime after it is issued. If the bond is called, the investor reinvests the call price (the face value plus the call penalty), CP, immediately at the current market rate of interest, i, until the end of the original N years. His expected (holding period) yield over the N years is the discount rate, r′, which equates the price of the security with the discounted value of the *expected* future income flows:[12]

$$(4) \quad P = \sum_{n=1}^{m} \frac{C}{(1+r')^n} + \sum_{n=m+1}^{N} \frac{(i)\,CP}{(1+r')^n} + \frac{CP}{(1+r')^N} .$$

The call date, m, and the market interest rate at the date of call, i, are clearly matters of uncertainty, unless there is a deferred call provision, in which case it is at least known that the bond cannot be prepaid before the end of the period of deferment. The attitude of the investor towards the price he is willing to pay for the security will clearly be influenced by the amount of call protection he gets—in terms of the period of deferment and the call price—and by his expectations of the degree and timing of future interest rate movements. A reasonable behavioral assumption is that a price will be determined at which the marginal investor will be indifferent between purchasing the security with a call provision versus one that is noncallable. That is, a price (or coupon) will be determined such that r′, the expected holding period yield (which depends on m, CP, and i), will equal r, the yield to maturity of a noncallable bond with a maturity of N years computed by formula (1).[13]

The general implications for yield spreads of the difference between formulas (1) and (4) are fairly straightforward. First, if interest rates are not expected to drop enough to justify the issuer of the security to prepay the face value of the security (given the presence of the call penalty and refinancing costs), then expectations will be that the security will not be called. Investors will not be willing to pay a premium (accept a lower yield) for call deferment provisions, and the yield to maturity formula (1) will give comparable yields for securities with different call provisions. If interest rates are expected to fall enough that the security will be called *and* if the subsequent expected holding period yield, as indicated by formula (4), becomes smaller than r, the yield to maturity of a noncallable security, then the

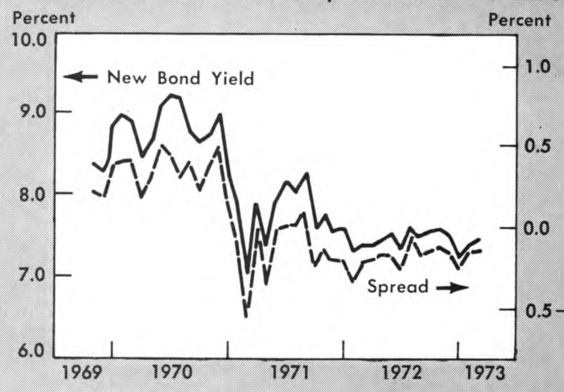
[11] In fact, part of the capital loss is deductible against current income. Introduction of this factor would make the spreads in Table V smaller.

[12] In order to keep the discussion manageable, taxes will be ignored in both this section and the next. Doing so does not affect any of the basic conclusions.

[13] This assumption implies, contrary to currently accepted theory, that investors do not demand a higher expected (than certain) return in exchange for the uncertainty associated with buying the security with the call provision. The same simplifying assumption is made in the next section with respect to another type of uncertainty. The assumption does not affect any of the general conclusions.

Chart 6

NEW BOND YIELD AND SPREAD BETWEEN NEW AND 8-8⅜ COUPON, SEASONED YIELDS



Note: Yield series are for Aa deferred callable utility bonds.

Source: Salomon Brothers, **An Analytical Record of Yields and Yield Spreads.**

coupons on the callable security will have to rise (or in the case of a seasoned security, the price will have to fall) in order to equate r and r′. Under these circumstances spreads will be created between *calculated* yield series for securities with different periods of call deferment.[14]

Salomon Brothers has calculated yield to maturity series up to 1969 for securities that are identical in all respects except that one set is immediately callable, while the other has a deferred call period of five years.[15] Therefore, the spread between these two series, shown in Chart 7, isolates the effect of five years call deferment. Given the above discussion, investor expectation has to be that interest rates will fall in the five years following any period when the immediately callable rate rises above the deferred callable rate. Otherwise, investors would not be willing to accept a lower yield in return for five years of call deferment. The chart shows positive values both in the early and late 1960's. The chart also demonstrates that, over the period shown, expectations of future interest rate changes moved inversely with respect to interest rate levels.

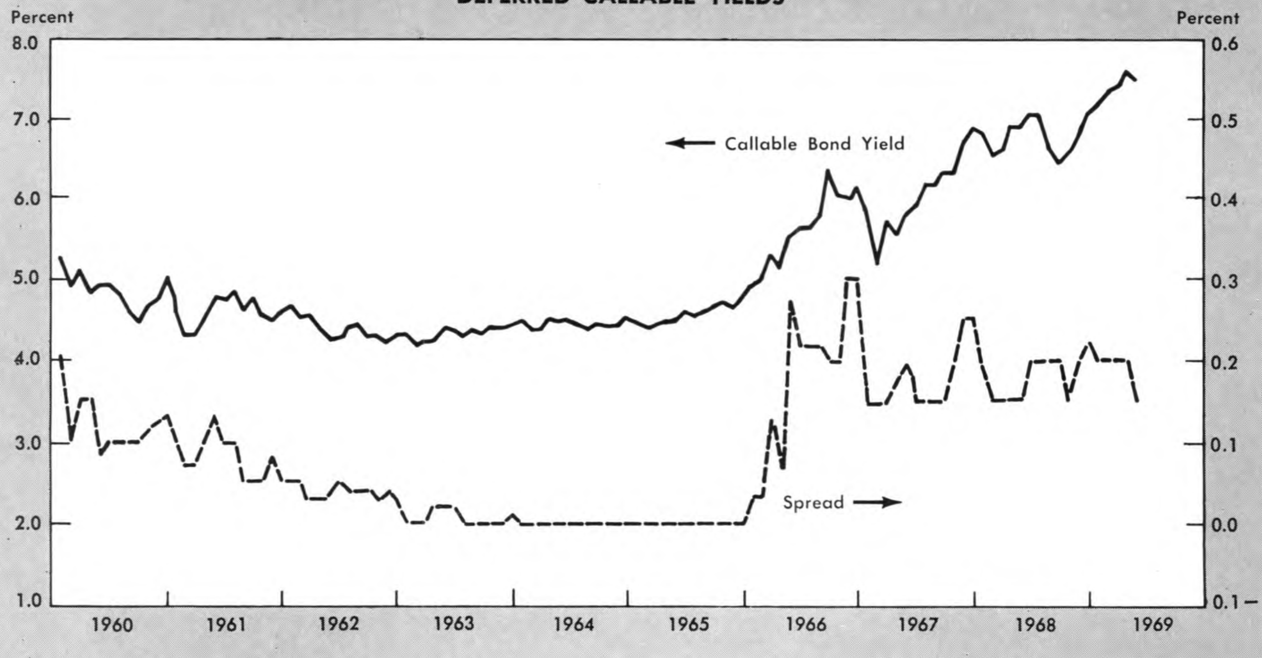
An alternative way of illustrating the effect of the call feature on yields is to compute the yield to call (by assuming the call price is paid at the end of the period of deferment) and compare it to the yield to maturity for a given security. As indicated by formula (4), a low value of expected future interest rates compared to current interest rates will raise coupons (or lower prices) on securities with a call provision, so that the higher yield on the security for the period until it is called will compensate for the lower expected yield thereafter. Chart 8 shows the spread between the yield to call and yield to maturity of 8½-9⅛ percent coupon Aa utility bonds with a five-year deferment period issued in 1970, at a time when long-term interest rates were at a record high. The chart supports the evidence from Chart 7 that when interest rates are high, purchasers of securities with call provisions demand to be compensated for the expected lower yields following the end of the deferment period. The differential in the two yields was wiped out before the end of the deferment period, however, when long-term rates fell at

[14] By imposing the condition that r in formula (1) equals r′ in formula (4), and by specifying values for CP, i, m, and N, specific spreads between calculated yields to maturity on bonds with different call provisions are implied. For instance, suppose a noncallable 20-year bond, selling at par, has a \$60 coupon and, consequently, a yield to maturity of 6 percent. Let CP = \$1000 + C and assume that interest rates are expected to fall to a "normal" level, i, in three years and remain at that level. If i equals 5.50 percent, then no premium will be demanded on bonds with less than 20 years call protection. However, if i is equal to 5.25 percent, the coupon on an immediately callable security will be \$65.70 and the coupon on a security with five years of call protection will be \$62.61. The calculated yields to maturity will be 6.57 percent and 6.26 percent, respectively, implying that investors demand a premium of 57 basis points to buy the immediately callable security and 26 basis points to buy the deferred callable security. The value of five years call protection would be 31 basis points.

[15] The series for immediately callable issues was discontinued in 1969 because of the absence of any new callable issues.

Chart 7

CALLABLE BOND YIELD AND SPREAD BETWEEN CALLABLE AND DEFERRED CALLABLE YIELDS



Note: Yield series are for new Aa utility bonds.

Source: Salomon Brothers, **An Analytical Record of Yields and Yield Spreads.**

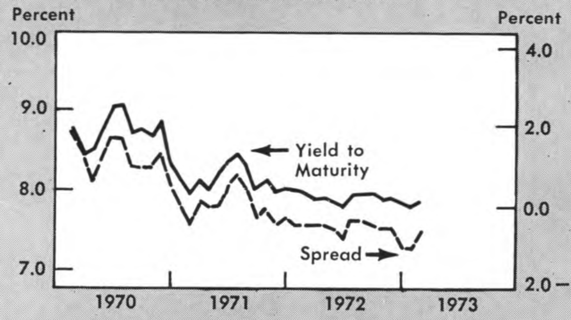
the end of 1970 and the beginning of 1971.[16]

Chart 7 shows the value of five years call deferment at different points in time arrived at by isolating that particular special feature. An important question posed by Chart 7 is what is the value and what is the effect on yield spreads of longer periods of call deferment? In particular, what is the value of call deferment until maturity (for 20 or 30 years) that characterizes state and local and most U. S. government bonds? The specific answer to that question is unknown, since there are no yield series that isolate longer periods of call deferment.[17] One can only speculate that in periods of high interest rates, such as 1969-1970, calculated yield series for securities with call provisions would rise significantly relative to long-term yield series for securities with complete call protection. It seems likely, for example, that part of the unexplained increase in the spread between the corporate bond and U. S. government bond rates in the late 1960's resulted because the latter series excluded bonds callable in less than 10 years. In any case, the point is that call provisions will not only affect the spreads between various corporate bond rates, but they will also affect spreads between yield series for corporate bonds and other types of long-term securities with longer periods of call deferment.

Yield series for mortgages, unlike those for the other long-term securities, are computed by assuming that the mortgage is called ("prepaid") at a date before maturity. Although there are often "prepayment penalties," they do not enter into the computation of commonly used yield series. For the yield series on conventional mortgages shown in Chart 1, the prepayment date assumption has little effect on the calculated yield series. For yield series on FHA-insured mortgages, however, the prepayment assumption can substantially affect the yield series, because FHA-insured mortgages sell at a discount when market yields are greater than the maximum permissible "interest rate" on the mortgages. In order to raise the effective yield of the mortgage, the purchaser adjusts the actual amount of the loan rather than the monthly payments. In the context of formula (1), when C is at the legal maximum, the yield, r, is adjusted by changes in P, the price of the

Chart 8

YIELD TO MATURITY ON 8½-9⅛ COUPON BOND AND SPREAD BETWEEN YIELD TO CALL AND YIELD TO MATURITY



Note: Yield series are for Aa seasoned utility bonds.

Source: Salomon Brothers, **An Analytical Record of Yields and Yield Spreads.**

mortgage. When the assumed prepayment date is changed for such discount mortgages, it can have a substantial effect on the calculated yield series. Chart 9 shows the usual FHA-insured yield series compared to a recomputed one[18] in which the call date assumption is changed from 15 to 10 years. The latter rate shows almost as much movement in the last 10 years as the corporate bond yield series in Chart 1. The spread between the conventional mortgage rate, shown in Chart 1, and the corporate bond rate, however, fell considerably during the same period.[19]

Default risk and yield spreads The fourth and last element in yield spreads to be considered results from the fact that the yield to maturity formula implicitly assumes that the promised returns associated with holding a particular security are known with certainty and that there is no risk of delay or failure in making those returns. In fact, there is default risk associated with holding most securities, and the amount of this risk as perceived by investors varies from security to security.

Consider, as an example, the situation of an investor faced with the option of buying one of two securities. The first one is, say, a United States government bond, which is assumed to be completely free of default risk. The yield to maturity, r_1, will be

[16] After setting values for CP, i, m, and N, and imposing the condition that r in formula (1) equals r′ in formula (4), the yield to maturity and yield to call on a deferred callable security can be calculated and compared. Because of the call penalty, a yield to call greater than yield to maturity *does not* necessarily imply an expectation of falling interest rates. However, given fixed interest rate expectations, a fall in interest rates from a level at which a deferred callable security has a higher yield to maturity than a noncallable security will decrease the spread between the yield to call and yield to maturity of the deferred callable security.

[17] One estimate is that the value of a 30-year call deferment in a period of high interest rates is 70 basis points. See Gordon Pye, "The Value of Call Deferment on a Bond: Some Empirical Results," *The Journal of Finance,* 22 (December 1967), 623-36.

[18] The series was recomputed through 1967 in an extremely interesting book by Jack M. Guttentag and Morris Beck, *New Series on Home Mortgage Yields Since 1951* (New York: National Bureau of Economic Research, 1970), p. 184. The series was recomputed from 1968 to the present by making the assumption that the relationship between the changes in the two series was the same as in the earlier period. If anything, the difference between the two series is underestimated in the latter period, since FHA-insured mortgages had even greater discounts in that period.

[19] Guttentag and Beck, *op. cit.,* pp. 63-70, provide a reasonable explanation, based on the behavior of the different sectoral participants in the two markets, for the greater movement of the FHA-insured mortgage rate series than the conventional mortgage rate series in the period under consideration.

accurately determined by formula (1) and will be known with certainty. The second security is a corporate bond for which the investor definitely feels there is some possibility that the issuing corporation will default, either by nonpayment or delayed payment of the coupons or face value of the bond. He will foresee a number of possible streams of returns associated with holding the bond, only one of which corresponds to the full promised amounts at the promised time periods. By employing formula (1) each possible stream of returns implies a different yield to maturity for the bond. The investor's *expected* yield to maturity on the second bond, r_2^e, can be thought of as the average of all the possible yields to maturity computed in this fashion. Clearly, if r_1, the *promised* yield to maturity on the risk-free bond, is equal to r_2, the *promised* yield to maturity on the bond subject to default risk, then r_1 will be greater than r_2^e, the expected yield to maturity on the risky bond. The investor, that is to say the market, will prefer the default-free bond to the one perceived to have default risk. This preference will drive up the price of the default-free security relative to the price of the risky security to the point where $r_1 = r_2^e$. Hence r_2, the *calculated* yield series on the risky security, will be greater than r_1. The difference between r_2 and r_1 is generally called the "market risk premium" for the risky security. In the world described above, it would equal $r_2 - r_2^e$, the "expected default loss" (difference between the promised and expected yields to maturity) on the risky security.

In the real world the perceived quality, or relative lack of default risk, on state and local and corporate securities is apparently determined largely by quality ratings made by investment agencies such as Moody's Investors Service. The market risk premium of a security wih a given rating is the spread between the yield series for that rating and that of a U. S. government security of comparable maturity.

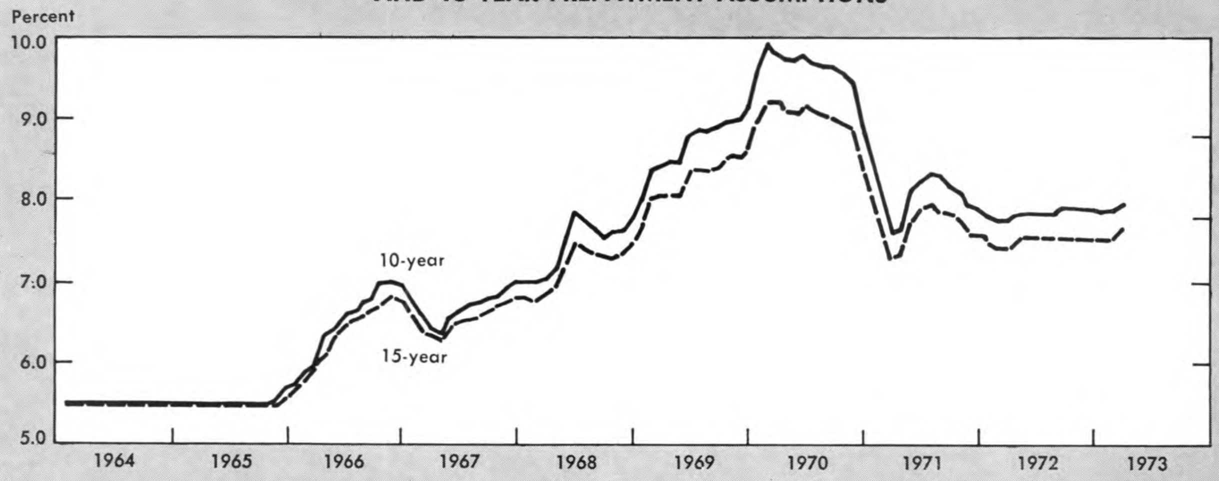
Chart 10 shows yield series for four categories of corporate bonds rated by Moody's. The highest, Aaa, is for "bonds with the smallest degree of investment risk; interest payments are protected by a large or by an exceptionally stable margin and principal is secure." The lowest rating shown, Baa, is for bonds whose "interest payments and principal appear adequate for the present but certain protective elements may be lacking or may be characteristically unreliable over any great length of time." Since none of the four yield series ever intersects, the opinions of investors, in general, correspond with those of Moody's.

A commonly asked question is what determines the quality rating of a particular security?[20] Variables that have been cited in response to that question fall into two predictable classes. The first set of variables is related to the balance sheet of the issuer of the security, and the second set to the size and stability of the issuer's net income flows. For example, balance sheet variables that have been determined to be related to the quality ratings of corporate bonds are (1) the ratio of long-term debt to total capitalization, a measure of leverage, and (2) the market

[20] Recent articles that have dealt with this question are Thomas F. Pogue and Robert M. Soldofsky, "What's in a (Corporate) Bond Rating?" *Journal of Financial and Quantitative Analysis,* 4 (June 1969), 201-28, and Williard T. Carleton and Eugene M. Lerner, "Statistical Credit Scoring on Municipal Bonds," *Journal of Money, Credit and Banking,* 1 (November 1969), 750-62.

Chart 9

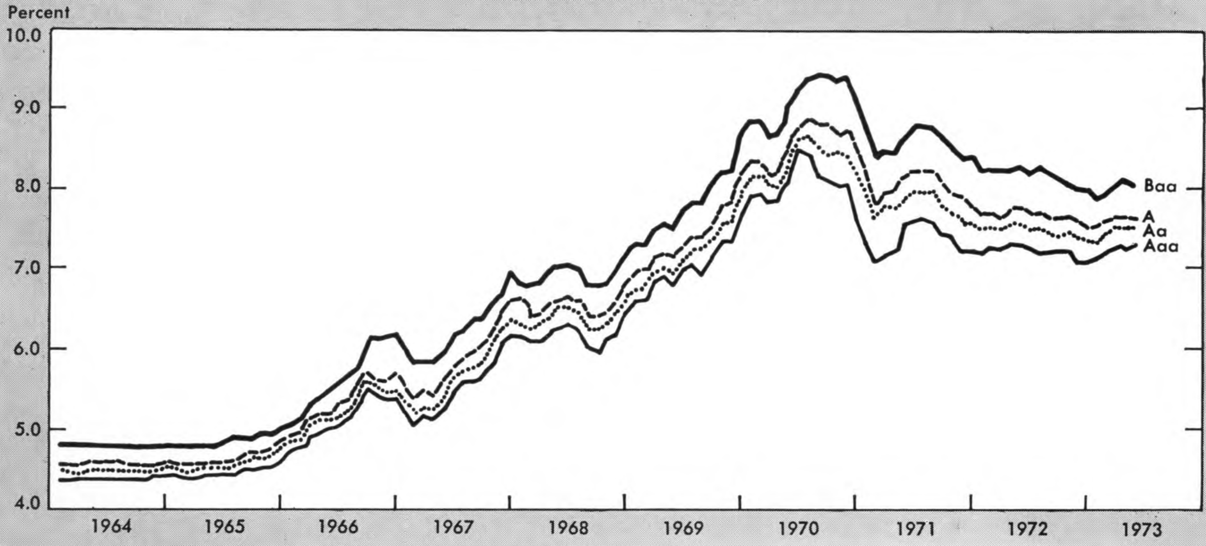
YIELDS ON FHA-INSURED NEW HOME LOANS WITH 10-YEAR AND 15-YEAR PREPAYMENT ASSUMPTIONS



Source: Federal Housing Administration.

Chart 10

YIELD SERIES FOR CORPORATE BONDS RATED Aaa, Aa, A, AND Baa BY MOODY'S



value of all publicly traded bonds of the company, a measure of marketability. Income variables that have been related to corporate bond ratings are the earnings variability of the company and the ratio of after-tax net income plus interest charges to interest charges, a measure of earnings coverage.

A second question is whether the yield spreads embodied in market risk premiums respond inversely to cyclical movement in economic activity. The spread between Moody's Baa and Aaa corporate bond yield series is shown in Chart 11. Clearly, the spread rose substantially in the recession of 1970, particularly in the fourth quarter, which was the worst. During the rest of the period, however, the spread did not move closely with changes in real GNP. The same general observation may be made for state and local rates over the period.

Table I shows that the spread between the corporate bond rate series and the long-term U. S. government bond rate series shown in Chart 1 reached its peak in the fourth quarter of 1970. In view of the previous discussion and Chart 11, it appears likely that the movement in the spread between the two interest rate series was affected not

Chart 11

SPREAD BETWEEN MOODY'S Baa AND Aaa CORPORATE BOND YIELD SERIES

only by the capital gains tax effect and call risk but also by a cyclical movement in default risk premiums.

The relationship of the special features to the other security characteristics The discussion at the beginning of this article centered around the notion that yield spreads could be neatly divided into three classes related to characteristics of marketable securities. The three classes of spreads were: (1) those associated with differences in maturity, (2) those associated with differences in economic sectors that issue and purchase various securities, and (3) those associated with differences in the four special features discussed in this article.

In reality, however, it is extremely difficult to isolate the part of an observed yield spread related to each of these characteristics, as has been shown with respect to the special features. It is useful to consider briefly the difficulties the presence of the special features can pose in attempting to isolate and explain the amount of an observed spread between security yields that is related to differences in maturity or to the behavior of the particular economic sectors that participate in the market for the securities. Two examples should suffice.

First, in discussing the movement in yield spreads over time related to different maturities (the term structure), U. S. securities are generally used. The implicit assumption is that these securities are alike in all respects except maturity. Table VI shows, however, that this was not the case in the period under consideration, since the long-term U. S. security yield series was for discount bonds. As the table indicates, a situation was created in which the securities also differed with respect to their tax treatment, implying upward bias, albeit small, in the U. S. security yield curve for maturities greater than five years. This bias increases as the difference between the coupon and current market rates increase and as taxes increase.[21]

Table VI

EFFECT OF TAXES ON TERM STRUCTURE OF BEFORE-TAX YIELDS

Effect of Taxes On The Term Structure of Before-tax Seasoned Security Yields (r) Assuming Equal After-tax Yields (r*)
C=40 cg=½t

		t=40%		t=50%	
r*	N	r	P	r	P
5.5	20	8.07	602.28	9.01	542.54
5.5	15	7.99	658.22	8.86	604.39
5.5	10	7.93	735.35	8.76	690.96
5.5	5	7.90	843.71	8.71	815.19
5.5	1	7.91	963.77	8.73	956.50

Attempts to isolate movements in yield spreads associated with the activity of different economic sectors are also difficult. For example, consider the case of an increase in U. S. government debt financed by long-term bonds. An interesting question is how will this action affect the long-term U. S. bond interest rate relative to other rates, such as the corporate bond rate. To attempt to answer this question, it is clearly desirable to have a corporate bond rate and a long-term U. S. bond rate for securities that are identical in all respects, in order to isolate the movement (if any) in the spread associated with the government debt financing operation. The relationship between the two interest rates in Chart 1, however, is also affected by capital gains tax treatment, by call risk, and by default risk.[22] Furthermore, in the period under consideration, there is no pair of long-term corporate and U. S. bond rates series that are not influenced by these factors.

Conclusion By focusing on the movement of interest rate series over the past 10 years, this article has attempted to demonstrate how the inability of the yield to maturity formula to deal with taxes and uncertainty in calculating yield series contributes to the creation and movement of observed spreads among various long-term interest rates. In particular, the article has shown that both income tax and capital gains tax rates have effects on observed yield spreads that vary with interest rate movements. The article also has illustrated the effect of call provisions on observed yield spreads and has shown how default risk influences yield spreads.

The article has made no attempt to explain elements of observed yield spreads associated with differences in maturity or associated with the behavior of different economic sectors. The article has pointed out, however, that these questions, particularly the latter, are greatly complicated by the effect on the level and movement of yield spreads of the four special features discussed.

Timothy Q. Cook

[21] The effect of taxes on the term structure of U. S. security yields was discussed by Alexander A. Robichek and W. David Niebuhr in "Tax-Induced Bias in Reported Treasury Yields," *Journal of Finance*, 25 (December 1970), 1081-90.

[22] Of course, an even greater problem is that there are other economic sectors that are simultaneously acting in the securities markets, thereby influencing the relative yields.