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The Determination of Yield Differentials Between Debt Instruments of the Same Maturity

I. Introduction*

DEBT INSTRUMENTS of comparable risk level and maturity and with similar provisions do not necessarily have the same market yield. Moreover, the yield differentials between different instruments of comparable risk level and maturity vary considerably over time. In June, 1964, for example, the yield differential between AA-rated utility bonds and government bonds of the same maturity was 30 basis points (30/100 of one per cent), whereas in June, 1969 the differential was 147 basis points.[1] The yield spread between utility and industrial bonds of comparable quality and with similar provisions (call features, coupon size, etc.) has also varied over time, the differential being positive during certain periods and negative during others.

The purpose of this paper is to examine the yield differentials among three types of debt instruments: long-term United States government bonds, high quality utility bonds, and high quality industrial bonds. These three categories of bonds are of roughly the same maturity and risk level. The default risk for the high quality utility and industrial bonds considered in this study is essentially negligible, as is, of course, the default risk for U.S. government bonds. In Section II the question of why the three types of bonds are not perfect substitutes for one another is examined. A simple model determining the yield differentials is then developed in Section III, and the results of estimating the model are presented in Section IV.

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[1] The interest-rate data employed in this study are discussed in the Appendix.

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II. Preferences for Alternative Types of Debt Instruments of the Same Risk Level and Maturity

This section is devoted to an examination of the reasons why alternative debt instruments of the same risk level and maturity are not necessarily perfect substitutes for one another. Starting from a situation where the rates for government, industrial, and utility bonds were equal, would a *ceteris paribus* increase in, say, the rate of return on utility bonds lead all investors to substitute utility bonds for the government and industrial bonds in their portfolios? It will be argued here that these three types of bonds possess different attributes, which differentiate them in the minds of investors, and consequently that the three types of bonds are not perfect substitutes.

In the theory of the term structure of interest rates, an extensive literature has accumulated to explain why alternative investors may have preferences for different maturities of the same bond issuer. It is argued, for example, that investors with short holding periods will often prefer to invest in short-term securities even if short- and long-term issues have the same expected yield over the investment period. This is so for two reasons. First, an investor with funds at his disposal for, say, 90 days who buys a 3-month Treasury bill and holds it to maturity incurs far less in transactions costs than an investor who buys a 20-year Treasury bond, holds it for 3 months, and then sells it in the market. Secondly, the latter investor incurs the risk of a substantial variance in holding-period return, whereas the former investor can be assured of receiving the market 90-day bill yield by investing in Treasury bills. By a fully analogous argument, it can be shown that investors with long holding periods will prefer, *ceteris paribus*, to invest in long-term securities. In such a way it is possible to build up a "preferred-habitat theory" of the term structure of interest rates.[2]

A similar kind of analysis can be made for preferences among different types of debt instruments of the same maturity. To the extent that the different types of debt instruments possess different attributes, investors may exhibit differing preferences for one type of debt instrument over another. Some investors, for example, may have a strong preference for government bonds over corporate bonds and may be willing to hold government bonds even if the corporate yield is much higher, whereas other investors may be nearly indifferent between the two bonds and may be induced to change from one to the other by small changes in the yield differential. Three of the attributes that appear to be important for long-term bonds are (1) the extent to which the bonds are needed to meet various legal requirements, (2) the "window dressing" quality of the bonds, and (3) the ease with which the bonds can be resold.

The first attribute serves to distinguish government bonds from corporate bonds. It relates to the various legal restrictions under which many financial

[2] This term is used by Modigliani and Sutch in [5] and [6]. Similar types of analyses may be found in Robinson [8] and Malkiel [4].

institutions operate. Commercial banks, for example, must keep government bonds on hand to secure public deposits (i.e., deposits of federal, state, and local governments). Moreover, many financial institutions, such as commercial banks and savings and loan associations, are restricted from freely buying corporate bonds. Legal restrictions are thus an important influence on the portfolio allocations of many investing institutions.

The second attribute relates to the window dressing quality of bonds and serves to distinguish many different types of bonds. With respect to government bonds, many financial institutions, even if they are not required by law to limit their holdings of marketable securities to government bonds, may nevertheless feel that their "public image" is enhanced by reporting large holdings of government bonds. Since long-term government bonds are usually carried on a separate line in their balance sheets, it is quite obvious to all observers precisely what portfolio allocations have been made.

These window dressing considerations may be particularly important for financial intermediaries who are subject to examination by public authorities. Such institutions find it important to hold a substantial fraction of their portfolios in so-called non-risk assets, of which government bonds are the prime example. Although the high-grade corporate bonds considered in this study are in effect also non-risk assets, they are not considered to be so by many public authorities. Consequently, financial intermediaries who are under the examination of these authorities are likely to prefer to hold government bonds even at a considerable yield sacrifice, whereas those institutions who are not subject to such examination are unlikely to exhibit such preferences. It should be emphasized that such preferences for government securities are not necessarily legislated by the public authorities. It is rather a traditional reluctance to show a balance sheet that may arouse the suspicion of the examiner.

An analogy might be made to the discount mechanism and commercial-bank behavior. It has long been argued that bankers have a traditional reluctance to go to the discount window for borrowing. When the spread between the Treasury bill rate and the discount rate widens, however, much of the reluctance breaks down and bankers do borrow under such circumstances. The point is that the reluctance is in no sense a general prohibition. When the advantage of borrowing becomes large enough, even very reluctant institutions will utilize the discount rate privilege. Similarly, institutions who hold large quantities of government securities in order to window dress their balance sheets for the public authorities will tend to alter the composition of their portfolios in favor of the higher yielding securities when the advantage of holding non-government securities becomes great enough.

Window dressing considerations also serve to distinguish different types of corporate bonds. While the highest quality corporate bonds that are dealt with in this study are essentially free of default risk, financial institutions still like to have many different individual issues in their portfolios and like to diversify their portfolios among different categories of bonds. Such diversification is said to result in a well-represented portfolio that creates an image of service to the broad industrial community. In particular, institutions appear to prefer to balance their portfolios between industrial and public utility bonds. During a period when most of the new issues are of utility bonds, there will usually be active bidding for the limited supply of industrial bonds, and such industrial issues can be expected to command a sort of scarcity premium.[3]

The third attribute serves to distinguish government bonds from corporate bonds. U.S. Treasury bonds enjoy the "broadest, deepest, and most resilient secondary market" of any of the debt instruments, whereas corporate bonds tend to be issued in relatively small amounts and are often infrequently traded. A million dollar holding of a corporate issue of which only fifty million dollars is outstanding may, for example, be extremely difficult to sell without significantly depressing the market price. On the other hand, the sale of a million dollars of government bonds, which are outstanding in the billions of dollars, can usually be made with ease. Thus, the transactions costs of dealing in government bonds are likely to be much lower than the costs of dealing in corporate bonds.[4] This suggests that investors who change their portfolios quite frequently (or who tend to have relatively short holding periods) are likely to have a stronger preference for government bonds than are investors who change their portfolios less frequently. In particular, bond speculators are likely to prefer government bonds, other things being equal, because of their high marketability and low margin requirements.

Before concluding this section, it should be pointed out that it would still be possible for government, industrial, and utility bonds to be perfect substitutes for each other despite decided preferences on the part of some individual investors. As long as a group of speculators were indifferent among the different categories of bonds, they could engage in arbitrage operations until any yield differentials disappeared. For example, suppose public utility bonds

[3] As mentioned above, lower quality corporate issues, whose yields may be affected by liquidity scares and some element of default risk, have not been included in this analysis. The corporate bonds under consideration in this study are of high quality and have been assumed to be free of default risk. This assumption may be justified in part by the following evidence. During 1970 several merchant marine bonds, which are government guaranteed and thus free of default risk but which have other attributes similar to corporate bonds, sold at approximately the same yield as did the highest quality corporate bonds. This yield was approximately 175 basis points higher than the yield on the highest yielding long-term Treasury bond. Nevertheless, even if the corporate bonds considered here do have some element of default risk, "riskiness" may be considered to be a fourth attribute serving to differentiate the types of long-term bonds. The general analysis would proceed without change.

[4] This third attribute—differences in the marketability of the alternative categories of bonds—is partly a result of the existence of the former two attributes. Differences in transactions costs exist because individual issues of corporate bonds are imperfect substitutes. The window dressing characteristics described above serve even to distinguish individual issues of subsidiaries of a single company, such as The American Telephone and Telegraph Company. Portfolio managers feel that a diversified portfolio containing bonds of different AT&T local subsidiaries helps create an impression of broad geographic participation in the economy. Of course, the different local telephone company bonds are closer substitutes than are industrial, utility, and government bonds of comparable quality and maturity.

yielded more than industrial bonds. A simultaneous purchase of utility bonds of the same maturity and (short) sale of industrial bonds would guarantee the arbitrageur a yearly profit over the life of the bonds. High transactions costs and the difficulties involved in selling bonds short in the market, however, make such an operation impractical.

III. The Determination of Yield Differentials

It has been argued in the preceding section that government bonds, high-quality utility bonds, and high-quality industrial bonds are not perfect substitutes. Consequently, it would seem reasonable to postulate a normal demand schedule for each of the assets in question, where the demand for each asset depends positively on its own rate of interest and negatively on the other rates of interest.[5] Let *SG*, *SU*, and *SI* denote the outstanding stocks of long-term government, utility, and industrial bonds respectively, and let *RG*, *RU*, and *RI* denote the respective rates on these bonds. Also, let *SA* denote the stock of all other assets that are substitutable in investors' portfolios for the three assets in question, and let *RA* denote some representative yield on these other assets.[6] Then the demand schedules for the four assets are postulated to be:

$$SG^d = a_{GG}RG + a_{GU}RU + a_{GI}RI + a_{GA}RA + b_G W, \tag{1a}$$

$$SU^d = a_{UG}RG + a_{UU}RU + a_{UI}RI + a_{UA}RA + b_U W, \tag{1b}$$

$$SI^d = a_{IG}RG + a_{IU}RU + a_{II}RI + a_{IA}RA + b_I W, \tag{1c}$$

$$SA^d = a_{AG}RG + a_{AU}RA + a_{AI}RA + a_{AA}RA + b_A W, \tag{1d}$$

where SG^d, SU^d, SI^d, and SA^d denote the demands for the respective assets and where *W*, wealth, denotes the sum of the four assets. The equation system (1a)–(1d) states that the demand for each asset is a function of the own rate on the asset, the yields on competing assets, and the stock of wealth to be distributed among the assets.

The equation system (1a)–(1d) is similar to the system derived by Parkin [7].[7] The portfolio model of Parkin, however, is much different than the model

[5] The demand schedule for each asset is, of course, an aggregate of the various individual demand schedules. For some individual investors, the various assets may be perfect substitutes for one another, and thus the individual demand schedules for these investors will be perfectly elastic. The existence of these types of investors is not inconsistent with the theory developed in this paper. All that is argued here is that there are enough investors for which the assets are not perfect substitutes for one another to make the *aggregate* demand schedules less than perfectly elastic.

[6] Because of the practical difficulties involved in measuring *RA*, enough assumptions will be made in the analysis below so that *RA* does not enter the final equation to be estimated. *RA* is introduced here for sake of completeness.

[7] See also Hendershott [1].

here. The Parkin model is based on the assumption that there is uncertainty about the yields on the various assets (and thus uncertainty about the total level of profits per period) and that investors maximize the expected value of their utility functions subject to their budget constraints. In the present model there is no uncertainty, and the demand schedules are based on the assumption that the different assets, although they are the same with respect to maturity and risk, embody different attributes.

In the Parkin model the b_i coefficients in the equation system (1a)–(1d) sum to one, and the a_{ij} coefficients form a symmetric matrix in which each of the rows (and thus each of the columns) sums to zero. The present model is less rigorous than the Parkin model, and fewer constraints can be imposed *a priori* on the coefficients. Because the sum of the four assets is W, the b_i coefficients do have to sum to one and each of the *columns* of the a_{ij} matrix has to sum to zero, but nothing in the development of the model requires that the a_{ij} matrix has to be symmetric. Nevertheless, symmetry seems to be a reasonable property to impose on the a_{ij} matrix, and making this assumption, the equation system (1a)–(1d) can be written (also using the property that each of the columns of a_{ij} sums to zero):

$$SG^d = a_{GU}(RU - RG) + a_{GI}(RI - RG) + a_{GA}(RA - RG) + b_G W, \quad (2a)$$

$$SU^d = a_{GU}(RG - RU) + a_{UI}(RI - RU) + a_{UA}(RA - RU) + b_U W, \quad (2b)$$

$$SI^d = a_{GI}(RG - RI) + a_{UI}(RU - RI) + a_{IA}(RA - RI) + b_I W, \quad (2c)$$

$$SA^d = a_{GA}(RG - RA) + a_{UA}(RU - RA) + a_{IA}(RI - RA) + b_A W. \quad (2d)$$

Equation (2d), which deals with the demand for all other substitutable assets, is not of interest in the present analysis, and it can be dropped from further consideration. This leaves the equation system (2a)–(2c), which encompasses six different a_{ij} coefficients: a_{GU}, a_{GI}, a_{UI}, a_{GA}, a_{UA}, and a_{IA}.

In order to simplify matters further, it will be assumed that a_{GU}, a_{GI}, and a_{UI} are equal (to, say a_1), that a_{GA}, a_{UA}, and a_{IA} are equal (to, say, a_2), and that b_G, b_U, and b_I are equal. This then allows the system (2a)–(2c) to be written:

$$RU - RG = -\frac{1}{3a_1 + a_2}(SU^d - SG^d), \quad (3a)$$

$$RI - RG = -\frac{1}{3a_1 + a_2}(SI^d - SG^d), \quad (3b)$$

$$RI - RU = -\frac{1}{3a_1 + a_2}(SI^d - SU^d). \quad (3c)$$

The equation system (3a)–(3c) states that the yield differential between each pair of assets is a function of the difference in demands for the assets. The coefficient $-1/(3a_1 + a_2)$, which enters all three equations, is positive, since a_1 and a_2 are both assumed to be negative. The advantage of equations (3a)–(3c) for empirical purposes is that comparisons can be made between different pairs of assets without having to consider the yields or demands for any other assets.

The assumption that b_G, b_U, and b_I are equal implies that an increase in total wealth, other things being equal, is distributed equally among the three assets.[8] The assumption that a_{GA}, a_{UA}, and a_{IA} are equal implies that a change in RA, the representative yield on other assets, has the same effect on all three assets and does not affect the demand for one type of asset more than another. Finally, the assumption that a_{GU}, a_{GI}, and a_{UI} are equal implies that RU and RI have the same effect on SG^d as RG and RI have on SU^d and as RG and RU have on SI^d. For example, a *ceteris paribus* increase of, say, 10 basis points in either the utility or industrial yield decreases the demand for government bonds by the same amount as a 10 basis-point increase in the government or industrial yield decreases the demand for utility bonds. While all of these assumptions are restrictive, they are necessary if the yield differential between a given pair of assets is to be analyzed without having to consider the yields on other assets.[9]

The supplies of government, utility, and industrial bonds are assumed to be exogenous in this study,[10] so that the supply schedules are:

$$SG^s = SG, \tag{4a}$$

$$SU^s = SU, \tag{4b}$$

$$SI^s = SI, \tag{4c}$$

where SG^s, SU^s, and SI^s denote the supplies of the respective assets. Assuming that the securities markets are in equilibrium, so that supply equals demand, equations (3a)–(3c) and (4a)–(4c) imply that:

[8] More realistically, it might be assumed that an increase in wealth is distributed among the assets in proportion to the amounts that are currently held. This could be done in the present analysis if the wealth variable were dropped from the right hand side of equations (1a)–(1d) and the left-hand-side variables written as SG^d/W, SU^d/W, etc. The problem with this specification for present purposes is that data on W are not available, since data on SA are not available. Also, as discussed in the Appendix, the initial levels of SU and SI could not be measured very precisely, which means that the ratios will be measured with errors. This problem does not arise for the equations below because the errors in measuring the initial levels are merely absorbed in the estimates of the constant terms.

[9] The above assumptions are, of course, only further types of symmetry assumptions, and they do not appear to be unreasonable as a first approximation. In a more complete study, the equation system (2a)–(2d) could be estimated directly and the validity of the assumptions could be tested. The data collection problems involved in such a procedure are quite severe, however, and such an undertaking is beyond the scope of this study.

[10] To the extent that supplies are not exogenous, but rather respond to the level of yields, then the estimates below will suffer from simultaneous equation bias. Consequently, in a more complete study, such as the one outlined in footnote 9, the possibility of simultaneous equation bias should also be considered.

$$RU - RG = -\frac{1}{3a_1 + a_2}(SU - SG), \quad (5a)$$

$$RI - RG = -\frac{1}{3a_1 + a_2}(SI - SG), \quad (5b)$$

$$RI - RU = -\frac{1}{3a_1 + a_2}(SI - SU). \quad (5c)$$

Equation (5c), for example, states that the spread between utility and industrial yields is solely a function of the relationship between the supplies of the two assets. An increase in the supply of utility bonds relative to the supply of industrial bonds can be expected to increase the yield differential between utility and industrial bonds. Similar statements can be made for the other yield differentials.

IV. The Results

Given data on RG, RU, RI, SG, SU and SI, equations (5a)–(5c) can be estimated. In the Appendix, the data that have been used in this study are discussed and the provisions of the various categories of bonds are described. Monthly data on the stocks of utility and industrial bonds (SU and SI) were collected from published and unpublished records of the Securities and Exchange Commission (SEC) and monthly data on the stock of government bonds (SG) were obtained from monthly issues of the *Treasury Bulletin*. Monthly interest-rate data were obtained from records prepared by Sidney Homer and associates of the investment firm of Salomon Brothers and Hutzler and from yield series compiled by Moody's Investors Service.

In Table 1 the various variables that have been used for the results below are listed. Three yields from Moody's have been considered—one each for utility, industrial, and government bonds—and four yields from Homer and associates have been considered—three for utility bonds and one for government bonds. As discussed in the Appendix, the yield data from Homer are more satisfactory in several respects than Moody's yield data. Moody's yield data were used only because data on industrial yields could not be obtained from Homer. Of the three utility yields from Homer, the yield on call-protected new issues ($RUH1_t$) appears to be most responsive to current bond-market conditions. Emphasis should thus be placed on the results achieved using Homer's data, and particular emphasis should be placed on the results achieved using $RUH1_t$.

Table 1 indicates that a series on the "visible supply" of utility bonds has also been considered. This is a series on the expected future flow (within the next six months) of public utility bonds. Each month the Irving Trust Financ-

TABLE 1

THE VARIABLES USED

RUM_t	=	Moody's Utility yield (monthly average of daily yields)
RIM_t	=	Moody's Industrial yield (monthly average of daily yields)
RGM_t	=	Moody's Government yield (monthly average of daily yields)
$RUH1_t$	=	Homer's Utility yield on new issues (end-of-month yield)
$RUH2_t$	=	Homer's Utility yield on outstanding bonds with current coupons (end-of-month yield)
$RUH3_t$	=	Homer's Utility yield on outstanding bonds with coupons between $4\frac{1}{8}$ and $4\frac{3}{8}$ per cent (end-of-month yield)
RGH_t	=	Homer's Government yield (end-of-month yield)
SU_t	=	Stock of Utility Bonds outstanding at the end of month t
SI_t	=	Stock of Industrial Bonds outstanding at the end of month t
SG_t	=	Stock of Government Bonds outstanding at the end of month t
VSU_t	=	"Visible Supply" of Utility Bonds at the end of month t

ing Calendar lists the dates during the next six months when various utility bonds are scheduled to be issued and the proposed amount of each issue. By adding up these totals each month, one can construct a series on expected future flows of utility bonds.[11]

The visible-supply variable was added to some of the equations explaining the yield differentials between utility and government, and utility and industrial bonds on the grounds that yield differentials may in part respond to expected future supplies. It may be, for example, that the relevant supply schedule for utility bonds is not equation (4b), but in fact is

$$SU^s = SU + VSU. \tag{4b$'$}$$

Equation (4b′) may be more relevant than (4b) in the sense that if investors have knowledge of VSU, the interest rate that clears the market for utility bonds may occur at the point where $SU^d = SU + VSU$, rather than where $SU^d = SU$. If (4b′) does hold, then equations (5a) and (5c) become:

$$RU - RG = -\frac{1}{3a_1 + a_2}[(SU + VSU) - SG], \tag{5a$'$}$$

[11] A series on the visible supply of total corporate (utility plus industrial) bonds is also available from the *Investment Dealers Digest*, and this series was considered in the initial phases of this study. The Irving Trust utility series was subtracted from the Investment Dealers Digest series in an attempt to obtain a visible supply series for non-utility or "industrial" issues. The resulting series was not significant in any of the industrial equations, however, and it was dropped from further consideration. The following results are thus based on the assumption that no useful information is available concerning the visible supply of industrial bonds for the six months ahead. This assumption in fact appears to accord with institutional practices. Negotiated industrial financings are almost never announced prior to registration with the SEC.

The results below are also based on the assumption that information about the visible supply of long-term government bonds is not available. This assumption also appears to accord well with actual practice, with one qualification. When the long-term government rate is above $4\frac{1}{4}$ per cent, the Treasury is prohibited by law from issuing debt with a maturity greater than 7 years. In this case the visible supply of long-term government bonds is known to be zero.

$$RI - RU = -\frac{1}{3a_1 + a_2}[SI - (SU + VSU)]. \qquad (5c')$$

Equations (5a′) and (5c′) suggest that the visible-supply variable should be added directly to the utility-stock variable, rather than as a separate variable, in the equations. The visible-supply variable was included as a separate variable in the regressions below, however, largely because of the desire to see whether the visible-supply variable was significant in its own right. Also, the theory upon which equations (4b′), (5a′), and (5c′) are based is crude, and in actual practice expected future supply is likely to affect interest rates in a more complicated way than the above theory suggests.

The (monthly) period of estimation that was used for the regressions was January, 1961, through June, 1969, for a total of 102 observations. All of the equations were estimated under the assumption of first order serial correlation of the error terms.[12] There are a number of reasons why the error terms in equations like (5a)–(5c) are likely to be serially correlated. Factors other than those specified in equations (5a)–(5c) may well affect yield differentials in the short run. Moreover, the yields on the different assets may adjust with different lags. For these and other reasons it is likely that the error terms in the various equations will be serially correlated.

For each yield differential in equations (5a)–(5c), the coefficient on the stock-differential variable is the same. No attempt was made in this study to impose this constraint on the regressions, however, and each yield differential was analyzed separately. As was the case for the visible-supply variable, the desire was to test for the significance of each of the stock-differential variables in its own right.

The results of estimating the various equations are presented in Table 2. For the estimates in the table, the interest rates are in basis points (i.e., 6 per cent equals 600 basis points) and the stocks are in millions of dollars. A constant term was included in each of the estimated equations to absorb any errors that may have been made in estimating the initial levels of SU_t and SI_t.[13]

The results in Table 2 appear to offer strong confirmation of the theory that yield differentials are influenced by stock differentials. For all four of the utility

[12] The equations were estimated by the Cochrane-Orcutt iterative technique.

[13] As discussed in the Appendix, it is quite likely that errors have been made in estimating the initial levels of SU_t and SI_t, and these errors will be absorbed in the estimates of the constant terms. The analysis in Section III can also be expanded to incorporate a constant term directly in equations (3a)–(3c). Attribute variables (such as window dressingness) can be added to the demand schedules (1a)–(1d), with certain restrictions placed on the coefficients of these variables, and the equations can be solved to yield equations like (3a)–(3c). The solved equations will then contain the attribute terms, and to the extent that the relative attributes do not change over time, the terms can be considered to be constant terms. If, for example, government bonds have more window dressingness than utility bonds, this should, other things being equal, cause the constant term in the $RU - RG$ equation to be positive. From the results in Table 2, however, the constant terms appear to be mostly picking up the errors made in estimating the initial levels of SU_t and SI_t.

TABLE 2

COEFFICIENT ESTIMATES OF THE VARIOUS EQUATIONS*

Equation Number	Dependent Variable	Constant	$SU_t - SG_t$	VSU_t	$\hat{\rho}$	R^2	SE
		Independent Variables					
1	$RUH1_t - RGH_t$	−143.10 (3.84)	.00479 (5.18)	.01376 (2.76)	.883	.947	9.37
2	$RUH2_t - RGH_t$	−119.73 (3.21)	.00428 (4.62)	.00473 (0.96)	.886	.940	9.26
3	$RUH3_t - RGH_t$	−42.51 (1.93)	.00186 (3.16)	.01011 (2.83)	.796	.877	7.89
4	$RUM_t - RGH_t$	−52.76 (1.45)	.00309 (3.61)		.899	.932	8.60
			$SI_t - SG_t$				
5	$RIM_t - RGM_t$	50.76 (4.39)	.00278 (2.58)		.916	.923	7.97
			$SI_t - SU_t$				
6	$RIM_t - RUM_t$	53.79 (2.58)	.00171 (2.83)		.794	.743	3.31
7	$RIM_t - RUM_t$	38.98 (1.73)	.00121 (1.78)	−.00228 (1.30)	.779	.747	3.30

* Notes: The numbers in parentheses below the coefficient estimates are t-statistics.
$\hat{\rho}$ is the estimate of the first order serial correlation coefficient.
R^2 is calculated taking the dependent variable in "untransformed" form.

versus government equations, the stock-differential variable is significant. It is most significant in equation 1, for which the new-issue utility yield was used. As discussed in the Appendix, the new-issue yield is probably the best indicator of current market conditions. The other three yields give good results as well, however, and the stock-differential variable is also significant in equation 4 using the less satisfactory data from Moody's. This latter result allows some confidence to be placed on the other results achieved using Moody's data. The visible-supply variable is significant in two of the three equations using Homer's data. For equation 4, using Moody's data, the visible-supply variable had a negative, but insignificant, coefficient estimate, and it was excluded from the final equation estimated. Concentrating on equation 1, which used the most satisfactory yield data, the visible-supply variable does appear to have independent power in explaining the yield differential between utility and government bonds.

In equation 5, comparing industrial and government yields, and in equation 6, comparing industrial and utility yields, the stock-differential variable is significant. When the visible-supply variable was added to the industrial versus utility equation (equation 7), its coefficient estimate was of the right sign (the sign should be negative in this case), but was not significant.

Notice that the estimates of the serial correlation coefficient are all quite high in Table 2, with a range of .779 to .916. These estimates of ρ probably indicate that the short-run adjustment lags have not been adequately captured or that relevant variables have been omitted from the equations. Other equations besides those listed in Table 2 were estimated, some using different lags or moving averages of the stock-differential variables and some using log or quadratic functional forms (with appropriate adjustments made for negative signs), but none of them seemed to be an improvement over the simpler equations in Table 2. The equations were also estimated over different sample periods. The general conclusion from estimating over different sample periods was that the sample period from January, 1968 through June, 1969 was quite important for the estimates. During this period utility bonds were rising quite rapidly in relation to industrial and government bonds and utility rates were rising rapidly in relation to industrial and government rates. Leaving the January, 1968–June, 1969 period out of the sample resulted in less significant (but in general still significant) estimates of the coefficient of the stock-differential variable in the utility versus government and industrial versus utility equations. The industrial versus government equations were less affected by changes in the sample period. The 1968 and 1969 observations thus appear to have added important new evidence that yield differentials are affected by stock differentials—something that was apparent, but less so, before 1968.

Looking at equation 1 in Table 2 more closely, the results indicate that a one-billion-dollar increase in the stock of utility bonds relative to the stock of government bonds increases the utility yield relative to the government yield by 4.79 basis points. A one-billion-dollar increase in the visible supply of utility bonds, on the other hand, increases the utility-government yield spread by 13.76 basis points. The visible supply of utility bonds thus appears to have a larger effect on the new-issue utility yield ($RUH1_t$) than does the outstanding stock of utility bonds.[14] A similar conclusion also holds for equation 3, (although not for equation 2), but less emphasis should be put on this result, since the utility yield used in equation 3 is not as good an indicator of current market conditions as in the yield used in equation 1.

In summary, the results of this study shown in Table 2 strongly support the theory that yield differentials of alternative bond instruments of the same maturity are influenced by the stocks of bonds outstanding and by the flow of anticipated new financing during the future six-month period. If better data were available, more sophisticated theories and hypotheses could perhaps be tested. This study suggests, however, that utility, industrial, and government

[14] Using the estimate of the variance-covariance matrix of the coefficient estimates in equation 1, the hypothesis that the coefficient of VSU_t is larger than the coefficient of $SU_t - SG_t$ was accepted at the 95 per cent confidence level.

bonds are not perfect substitutes and that the yield differentials between the various pairs of instruments are affected by the relative stocks outstanding.

Appendix: Description of the Data Employed

The principal data employed in this study consist of monthly estimates of the market yields of alternative debt instruments of comparable maturity and of the outstanding stocks of the various instruments. In general, the data on interest rates and stocks are not wholly satisfactory, but an attempt has been made to collect what seemed to be the best data available.

The most satisfactory data on interest rates are probably those prepared by Sidney Homer and associates of the investment firm of Salomon Brothers and Hutzler. The government bond yield that has been taken from Homer's yield series for use in this study is the yield on the "highest yielding representative long term treasury issues outstanding at any given time." [15] The yields on many long-term government bonds are influenced by a variety of special features such as optional maturities, partial tax exemptions, differing coupons, and peculiar marketability characteristics. Certain long-term government bonds, for example, when they are in the estate of a decedent, can be used at par value for the payment of federal excise taxes. Since these bonds are currently selling below 70 per cent of par value, this special feature makes such issues extremely attractive to some bond buyers, with the result that the yields of these issues are much lower than they otherwise would be. It is thus not an easy matter to determine the appropriate yield on long-term government bonds. Nevertheless, the yield on the "highest yielding bond" appears to be the most reasonable approximation of the long-term market yield for government bonds and it was used for the work here. The rates are all end-of-month rates.

Homer has also collected some useful series of the yields of public utility bonds. Three of these yields have been considered in this study. The first, and perhaps the most satisfactory, yield is the rate at which *new* utility bonds of the same quality with homogeneous call-protection features are sold. This yield gives a good indication of the state of the new-issues market, where most bond transactions actually take place. The bonds from which the yield series is constructed are AA-rated in quality and carry a five-year protection from call for purposes of refunding. The yield is estimated by bond traders to be the yield that would have been necessary to sell such new issues as of the end of each month. A comparison of these estimates against the actual yields of new issues made within a day or two of the end of each month revealed that the estimates were extremely close to those yields at which new issues were actually sold. The advantage of this new-issue yield is that it is likely to adjust almost im-

[15] Homer [3], p. 6.

mediately to changing market conditions. One disadvantage of this series is that the five-year call-protection offered on the utility bonds is far less than the approximately 20-year call-protection offered on the long-term government bonds used to construct the government yield series. The long-term government bond that normally has the highest yield matures in 1992 and cannot be called before 1987. This relative lack of call-protection may have become increasingly important during the late 1960's, when yields rose to unprecedented highs.

The second public utility yield considered in this study is a yield that is constructed from the yields of already outstanding ("seasoned") issues. The bonds from which this yield is constructed are again AA-rated in quality, and the coupon is taken to be the typical coupon at which current issues are being sold. There are, unfortunately, two possible difficulties associated with this yield series. First, because of limited trading in the secondary market, the yield may adjust only slowly to changing market conditions. Secondly, during periods when yields are rising very sharply and new bonds carry much higher coupons than those of already outstanding issues, it is impossible to find seasoned bonds with coupons similar to newly-issued securities. Consequently, the market yields may reflect the tax advantage of discount bonds, and the yield series may not give a good indication of the yield required to sell new bonds priced at par.

The third utility yield series considered in this study is a series constructed from the yields of seasoned utility bonds homogenous with respect to rating and coupon, but generally with much lower coupons than newly-issued securities. For the time period considered in this study the yields are taken from bonds with coupons between $4\frac{1}{8}$ and $4\frac{3}{8}$ per cent. This yield has the same disadvantage as the second yield in that it is based on yields of outstanding issues, which may not be actively traded and therefore may not adequately reflect current market conditions. It also has the further disadvantage that it is based on yields of bonds with fairly low coupons. Since these bonds sold at deep discounts throughout much of the period covered in this study, their yields may be significantly influenced by the favorable tax treatment of capital gains income. On the other hand, these low-coupon issues give essentially the same call-protection as long-term government bonds. While they technically are callable (at a premium over par), the possibility that such low-coupon issues will ever be called is probably so remote that their market yields are unaffected by the call provision.

In summary, the yield data obtained from Homer and associates appear to be satisfactory for present purposes, except for the few problems noted. Because it adjusts quickly to market conditions, the first yield is probably the best for use in this study despite the difficulty about call-protection. Unfortunately, Homer has not constructed yield series for industrial bonds. New issue series are not available because there are not enough new publicly marketed industrial bonds issued each month to be able to construct a consistent series over long periods of time.

Although they are not completely satisfactory, data on "seasoned" industrial yields are available from Moody's Investors Service. These data were used for some of the estimates in this study for lack of better alternatives. Moody's rates are monthly averages of daily rates, as opposed to end-of-month rates estimated by Homer. Consequently, the rates from these two sources are not directly comparable. Fortunately, data on utility and government yields are also available from Moody's, and these data could be used whenever the industrial yield was compared with either the utility or government yield. Since data on utility and government yields were available both from Homer and Moody's, it was possible to estimate equations explaining the yield differential between utility and government bonds using each data series in turn and then to compare the results. As noted in the text, one can judge from this comparison (see Table 2) how much confidence to place on the results of estimating equations explaining the yield differential between industrial and utility bonds or industrial and government bonds using Moody's data.

Two problems associated with Moody's data should be mentioned. First, Moody's calculates the yields from prices of bonds recorded on the New York Stock Exchange. When no trades have occurred, Moody's computes the daily yields from the latest bid price recorded on the exchange. The difficulty with this method is that most bond trading does not occur on an organized exchange, but rather takes place over-the-counter. It is quite possible that yields may have moved up sharply, yet the latest bid prices recorded on the exchange may not have changed. For example, during one period from the low of the market in 1957 to the peak in 1958 there was a very sharp rally in bond market prices (i.e., a very sharp fall in yields), but essentially no exchange trading occurred in the A-rated utilities used in Moody's average. Thus, the Moody's average, which continued to take the latest bid prices to calculate market yields, showed essentially no change over the period and failed to reflect the significant changes in market conditions. A second problem with Moody's yields is that they are constructed by using bonds with a wide variety of coupons. As mentioned above, bond yields may be significantly influenced by the coupon rates they carry.

It should also be mentioned that the existence of sinking funds for many industrial bonds may also tend to distort the relationship between the yields of newly-issued and those of seasoned securities. Sinking funds provide for the systematic purchase and retirement of a proportion of the outstanding bond issue in each year prior to maturity. If the seasoned bond is selling above its call price, the sinking fund will exercise the call provision to obtain the bonds required to be retired. On the other hand, if the bond is selling far below its call price (as has been the case for most bonds during the period covered by this study) the sinking fund will purchase bonds for retirement in the open market. This tends to raise the yields of seasoned industrial yields relative to seasoned utility yields since utility bonds do not generally have sinking funds.

The supply data on utility and industrial bonds were collected from published and unpublished records of the Securities and Exchange Commission (SEC). The statistical bulletin of the SEC publishes monthly new cash issues by corporate grouping.[16] This basic series includes both convertible and non-convertible bonds and both privately-placed and publicly-offered issues. Thus, it is necessary to subtract from this series all convertible bonds and privately-placed non-convertible bonds to derive a series on publicly-offered non-convertible bonds, which is the desired series for this study. All of the necessary data to make this adjustment for each of the two groups could be obtained from the SEC except for the breakdown by industry of publicly offered bonds into convertible and non-convertible categories.[17] To fill this gap, the ratio of publicly-offered convertible utility bonds to publicly-offered total utility bonds (only the latter being observed) was estimated each month to be the same as the (observed) ratio of publicly-offered plus privately-placed convertible utility bonds to publicly-offered plus privately-placed total utility bonds. This constructed series on publicly-offered convertible utility bonds was then subtracted from the observed series on total publicly-offered convertible bonds to yield a series on publicly-offered convertible industrial bonds.

In order to get the *net* change in the stock of publicly-offered non-convertible bonds outstanding for each of the two corporate groups, retirements of publicly-offered non-convertible bonds have to be subtracted from each of the new-issue series. Enough data could be obtained from the SEC to construct the two retirements series, although a few ratio assumptions similar to the one described above had to be made in order to do this. Using the retirements data, a series on the net change in the stock of publicly-offered non-convertible bonds was then computed for each of the corporate groups.

The model described above requires data on the outstanding *stocks* of bonds rather than on the net changes or flows of new issues. Stock figures were constructed by summing the flow figures for each group from a given initial value. Because of the linear form of the equations in Table 2, the initial value chosen for each group is arbitrary (the error in estimating the initial value of the stock is merely absorbed in the constant term in the equation). Since other functional forms were also estimated in the beginning phases of this study, however, an attempt was made to make the initial value for each group as realistic as possible. Initial values for 1944 for utility and industrial bonds were taken from the study of Hickman [1, Table 23] and each of these values was updated to the beginning of the monthly flow data by using annual SEC

[16] The eight SEC corporate groupings are: Manufacturing; Mining; Electric, Gas and Water; Railroad; Other Transportation; Communication; Financial and Real Estate; and Commercial and Other. For present purposes the "utility" group was taken to include Electric, Gas and Water and Communication, with the "industrial" group taken to include the other six. The grouping here does not exactly match the grouping used to construct the "utility" and "industrial" yields, but it is the best that could be done given the available data. The "industrial" series should perhaps be referred to as the "non-utility" series, but in this paper the word "industrial" was retained.

[17] Some of the data, however, could only be obtained on a quarterly basis. The quarterly figures were converted into monthly figures by dividing the quarterly figures by three.

flow data.[18] From the beginning of the monthly flow data on, the stocks were constructed in a straightforward manner from the monthly flows.[19]

The government supply figures were obtained from the Treasury Bulletin. Long-term bonds were taken to include all issues with a maturity of 10 years or longer. The supply of government bonds outstanding was taken to include only those bonds in the hands of the public: any bonds held by government trust accounts or by the Federal Reserve were netted from the total. One major difficulty with the data on government supply is that sometimes abrupt changes occur in the series as the maturation process causes large government issues to go from over 10 years to maturity to under 10 years to maturity. One would not expect a slight change in maturity length from one month to the next to have any pronounced effect on financial markets, and thus the series appears to be too rough. Attempts were made to smooth out the series (at the same time insuring that abrupt changes in the series resulting from new issues were left in), but the results achieved using the smoothed data were little different from those using the unsmoothed data. Thus, only the results using the unsmoothed data were presented in Table 2.

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[18] The annual SEC data did not go back as far as 1944, however, and so some of the annual flow data had to be constructed by backward extrapolation.

[19] It should be emphasized that the initial value estimates for the two groups are quite crude, especially considering the fact that the concepts and groupings used in this study and those used by Hickman are somewhat different.