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The Term Structure of Interest Rates and Inflation Uncertainty

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Term structure is the name applied to the pattern of yields on securities which differ only in their term to maturity. There are rather obvious reasons why market yields on different securities should not be the same, aside from maturity dates. Among the more important factors would be default risk, tax considerations, differences in coupon rates and marketability. Very simply, term-structure theory concentrates upon why securities which are alike in all respects, except in their term to maturity, should provide different market yields.

Term-structure theory can be used to explain the spread between long- and short-term interest rates or to explain the determinants of a long-term rate of interest. In this paper, we focus upon the latter application. Our analysis concentrates upon the functional specification and estimation of a long-term interest rate, specifically the new-issue corporate bond rate.

The term-structure theory used in this paper is the preferred-habitat model first proposed by Modigliani and Sutch in 1966.[1] More recently, Modigliani and Shiller have shown that the measurement of the term structure, based upon this theory, can be significantly improved when explicit allowance is made in the original Modigliani-Sutch equation for two additional factors, designed to measure the expected value of future inflation and the market's uncertainty about the future course of interest rates. The purpose of this paper is to make an addition to the Modigliani-Shiller equation which is in keeping with the preferred-habitat theory. We introduce into the term structure model a factor designed to measure the impact of changes in uncertainty about the future course of price inflation on the risk premium.

Our findings support the contention that the determinants of the risk premium, at least the systematic part of the risk premium estimated in the term-structure equation, can be explained by factors designed to measure inflation uncertainty and the uncertainty with which market participants foresee future interest rates. We conclude that inflation uncertainty has been a significant determinant of the term-structure risk premium—at least since the latter part of 1954 when our estimation period begins. A corollary is that changes in inflation uncertainty have changed the cost of capital investment, and that monetary authorities should begin to consider the influence of their policy actions on inflation uncertainty. The rest of this paper is devoted to a brief review of term-structure theory, the findings of Modigliani and Shiller, the extension of the model to cover inflation uncertainty, and our empirical results.

Theories of the term structure

The theory of the term structure is not a settled matter, as is seen from the principal models advanced to explain the relationship. Major models of the term structure include the pure-expectations, the liquidity-premium and the market-segmentation theories. Modigliani and Sutch combined major elements of each of these to provide a theory of the term structure which they refer to as the preferred-habitat version of the expectations model, or simply the preferred-habitat theory. We will briefly review these several theories, since the term-structure equations in this paper are based upon the basic postulates of these models.

Pure Expectations Theory. The pure-expectations theory begins with the assumption of a perfect or free market in securities—that is a market in which there are no default risks and no transaction costs, and in which securities are free of all other features which would lead one investment to be preferred to another, such as tax and call features, different coupons or marketability. In short, securities will be alike in all particulars except in their maturity dates. In this market, it is assumed that the behavior of each participant is motivated by the desire to maximize profits. The theory also asserts that although market participants do not know what actual interest rates will materialize in the future, they do form expectations of what future short-term rates will be, and they hold to these expectations with complete confidence. In such a market, an investor will be able to obtain the same yield, for a given holding period,[2] regardless of whether he purchases a security with a maturity date equal to the desired holding period, or any combination of maturities which he may hold over the same period. It follows that under such circumstances, the structure of yields on different securities can be explained by a very simple relationship—the current yield on a long-term bond of a given maturity is an average of the current short-term rate and all future expected short rates over the term to maturity.

The Liquidity Premium Theory. The liquidity premium theory modifies the above assumption of complete confidence in one's forecasts of future rates. This theory asserts that market participants form expectations of future rates but are uncertain about what actual rates will materialize, believing that future rates actually may turn out to be above or below their current expectations of these rates. Once uncertainty of future interest rates is introduced in the model, purchases of a long-term security will involve a risk of capital gain or loss over the holding period of the bond. The model further asserts that market participants are risk averters—that is, investors prefer to assume less risk rather than the chance of greater risk for a given expected return. Or, put another way, investors will assume more risk only if they anticipate greater expected returns. The twin assumptions of uncertainty and risk aversion imply that lenders of funds will prefer to purchase short-term investments in order to avoid the risk of capital loss associated with holding longer-term securities. Borrowers, on the other hand, generally have a strong preference for borrowing long, since borrowing is typically undertaken to finance long-term projects and borrowers wish to hedge against risk of fluctuations in interest costs. The theory concludes that if investors are to hold long-term securities, they must be compensated for the risk of capital loss which they assume. Under this theory, long-term rates will be greater than that implied by the pure-expectations theory by this risk or liquidity premium.

Market Segmentation Theory. The market-segmentation theory criticizes the above assertion that risk-aversion produces only a positive compensation for risk which must be paid to holders of long-term securities. This theory emphasizes that investors have different maturity preferences, and that some lenders prefer long-term rather than short-term investments. Investors, such as life-insurance companies or pension funds, are concerned with guaranteed certainty of income over the long run, and risk aversion on their part would lead to a preference for long-term securities. Other investors such as commercial banks would prefer to protect themselves against the risk of capital loss on securities, and would thus prefer to invest in short-term securities. In its extreme form, this model holds that regardless of the relative interest rate, investors will never shift out of their preferred markets. Accordingly, the yield structure is determined by the pressure of supply and demand within each of the segmented markets, since securities of different maturities constitute noncompeting groups.

Preferred Habitat Theory. The preferred-habitat model combines elements of all of the above theories. The current yield on a long-term bond of a given maturity is considered an average of the current short-term rate and all future expected short-term rates over the term to maturity. However, risk premiums must be taken into account. Different transactors are assumed to have different maturity preferences, with risk aversion leading a market participant to stay in his maturity habitat, unless other maturities offer an expected premium sufficient to compensate for the risk and cost of moving out of one's preferred maturity. According to this theory, the long term rate is expressed as an average of current and expected short term rates plus a risk premium, which may be positive or negative and which can vary with different maturities.

Modigliani-Shiller formulation

The securities whose yields are described in the term structure should be alike in all respects except in term to maturity. Accordingly, Modigliani and Shiller (MS) considered the relationship between the AAA corporate bond rate and the 4-6 month prime commercial-paper rate. The preferred-habitat theory leads one to express the AAA corporate bond rate as an average of current and expected future commercial-paper rates and a factor expressing a risk premium. Since expected nominal rates of interest can be expressed as equal to expected real rates of return plus the expected rate of inflation, MS express the expected commercial paper rate as the sum of the expected real rate and the expected rate of inflation. In their model of the formation of expectations, MS contend that market expectations of future values are based on the history of past values of the variable in question. Therefore, expected values in the term structure model can be replaced with weighted functions of current and past actual values. Specifically, the relationship implied by the preferred-habitat model can be written as:

$$R_t = \sum_{j=0}^{N} w_j I_{t-j} + \sum_{j=0}^{N} v_j P_{t-j} + K_t \qquad \text{(I)}$$

R = long term bond rate

I = real interest rate

P = rate of change in prices

K = risk premium factor

The model implies that the sum of the price weight (Σ v) should be unity, since if past rates of inflation remained constant over a sufficiently long time, the expected future rate should tend to coincide with it. By the same reasoning, the sum of the real interest rate weights (Σ w) will be unity. However, Modigliani and Shiller assert that the sum of the weights, w, may fall somewhat short of unity if the short term rate is expected eventually to regress toward some long-run normal level. In this latter case, the sum of the weights on the real interest term would be less than unity, and a constant positive value would be added to the equation.

Since the real rate of interest in equation I is not directly observable, MS eliminate the real rate from the equation by replacing it with the nominal rate less the rate of inflation ($r - P$), which leads to the following equation:

$$R_t = \sum_{j=0}^{N} w_j r_{t-j} + \sum_{j=0}^{N} v^*_j P_{t-j} + K_t \qquad \text{(II)}$$

where: r = nominal short term interest rate

$v^* = v - w$

The value of the sum of the newly defined inflation weights (Σv^*) should be zero if the sum of the weights w is unity, or should be close to zero in the case where the sum of these weights implies an expectation of a return to a long-run normal rate of interest.

Next, MS represent the risk factor, K, by a constant term and by a measure of the variation of the short-term interest rate over the recent past. The variation in the short-term rate is considered a reasonable measure of uncertainty regarding expected future rates. That is, the greater the variation observed in the short-term interest rate in the recent past, the greater is the probability that the actual future rate may differ from the expected rate. The variation in the short-term rate was measured by MS by an 8-quarter moving standard deviation of the commercial-paper rate. Finally, for estimation purposes, we are able to express the MS equation in the following manner:

$$RCB_t = c + \sum_{j=0}^{N} w_j RCP_{t-j} + \sum_{j=0}^{N} v^*_j P_{t-j} + RCPSD_t + u_t \quad \text{(III)}$$

where: RCB = AAA corporate-bond rate

c = constant term

RCP = 4-6 months commercial-paper rate

P = rate of change in the price deflator for consumption in the MIT-Penn-SSRC (MPS) quarterly econometric model of the U.S. The deflator differs from the Implicit Price Deflator for consumption in the NIA accounts in that consumption in the MPS model includes depreciation and net imputed rent on consumer durable goods which are excluded from the NIA calculation.

RCPSD = 8-quarter moving standard deviation of RCP

u = stochastic error term

N = 18 quarters

The length of the distributed lag is 18 quarters for both the commercial paper rate and the rate of inflation. The coefficients of the 17 lagged values are estimated by Almon's polynomial technique, while the current value of each variable is estimated separately. This method was used by MS, since this appeared the best way to capture the shape of the lag distribution implied by a combination of extrapolative and regressive elements in the formation of expectations, as suggested by deLeeuw. We continue this method in all the equations in this paper, unless otherwise stated.

Modigliani and Shiller's estimation results are reported in equation 1, Table 1. MS found a good fit for their equation over the period 1955.3-1971.2, with a standard error of 12.7 basis points. The equation was able to account for 99 percent of the variation in the long rate, and the form and the sum of the weights of the lag structures conformed to the MS model of the formation of expectations. However, the Durbin Watson statistic for this equation is quite low (1.01), which indicates the presence of positive serial correlation in the error term and suggests the exclusion from the equation of an explanatory variable in determining the spread between the short and long interest rates.

Removing serial correlation

One factor which may affect the AAA corporate bond rate and which is excluded from equation I is the favorable tax status of seasoned bonds represented in the AAA corporate bond rate. Because coupon-seasoned issues sell at a discount below par, the holder has a proportion of his interest income taxed as a capital gain. With tax rates on capital gains considerably below those on ordinary income, bondholders should prefer seasoned issues to new issues of corporate bonds. The favorable tax status of seasoned bonds, therefore, might be an added influence on the yield spread. For this reason, we re-estimated the basic MS equation, using for the long-term rate the new issue corporate-bond rate—rather than the AAA corporate-bond rate—in the hopes of reducing if not removing the serial correlation. The results are presented as equation 2 in Table 1.

First, the Durbin Watson statistic of 1.83 implies the absence of serial correlation, which supports our contention that the favorable tax status of seasoned bonds is a factor affecting the term structure estimation. Next, the remaining estimation results are consistent with the original MS findings, and support the preferred-habitat model description of the term structure. Specifically, the equation is able to account for

Table 1

Estimated Term Structure Equations

						RCP		P				
Eq. No.	Period of fit	Dependent Variable	Constant	RCPSD	PSD	Current	Sum of* Lagged Coeff.	Current	Sum of* Lagged Coeff.	$\bar{R}^2$	D.W.	S.E.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	1955.3— 71.2	RCB	.726 9.68	.24 2.00	—	.265 8.28	.691 15.02	.022 1.16	.137 2.21	.993	1.01	.127
2	1954.4— 71.2	RCBNI	.724 7.52	.529 3.75	—	.304 10.02	.553 11.06	.069 2.91	.271 4.30	.987	1.83	.175
3	1954.4— 71.2	RCBNI	.513 3.93	.391 2.62	.258 2.30	.316 10.63	.583 11.66	.045 1.78	.264 4.33	.987	1.84	.169
4	1954.4— 65.4	RCBNI	.793 2.62	.666 3.92	—	.313 6.44	.553 6.91	.042 1.18	.193 2.38	.899	1.88	.160
5	1954.4— 65.4	RCBNI	—.172 —.479	.323 1.91	.625 3.85	.332 8.02	.769 8.74	.014 .383	.180 2.65	.928	2.38	.136
6	1954.4— 65.4	RCBNI	—	.338 2.05	.571 4.96	.328 8.23	.733 16.29	.012 .383	.175 2.61	.929	2.33	.134
7	1966.1— 71.2	RCBNI	—4.28 —.88	.822 1.40	—	.170 1.02	2.98 1.44	.123 1.65	—1.62 —1.00	.982	2.88	.168
8	1966.1— 71.2	RCBNI	—2.82 —.664	.743 1.46	.605 2.26	.190 1.32	2.18 1.20	.147 2.25	—.946 —0.665	.987	3.51	.145
9	1966.1— 71.2	RCBNI	—	.717 1.45	.632 2.44	.168 1.23	1.02 2.18	.176 3.71	—.241 —.747	.987	3.41	.141

Definition of Variables and Sources

RCB = AAA Corporate Bond Rate

RCBNI = New issue rate, AAA Utility Bond. *Federal Reserve Bulletin,* Table A36. Data begins in 1960. Before 1960 the series was extended backward using an unpublished new issue series for all corporations compiled by the Federal Reserve.

RCP = Commercial Paper rate. *Federal Reserve Bulletin,* "Money Market Rates, Prime Commercial Paper 4-6 Months." Quarterly averages of monthly figures.

RCPSD = 8-quarter moving standard deviation of RCP.

P = Annual rate of change in the price deflator for consumption in the MIT-Penn-SSRC Econometric Model of the U.S.

PSD = 8-quarter moving standard deviation for PSD.

*Method of estimation = Almon Third Degree Polynomial Distributed Lags, constrained to be zero at the left-hand tail of the distribution, 17 quarters.

S.E. = Standard error of the equation.

D.W. = Durbin Watson statistic.

R^2 = Adjusted Correlation Coefficient.

The first line of numbers represents estimated coefficients; the second line represents the t-statistic of the coefficients.

about 99 percent of the variation in the long rate and, considering the greater variation in the new-issue rate as compared to the seasoned-bond rate, the fit is very close. The equation predicts the new-issue rate with a standard error of only 17.5 basis points for the entire sample period. The sum of the coefficient of the commercial-paper rate is less than unity, and the sum of the coefficients (v), which represents the weights in the formation of price expectations, is 1.20 (the sum of the coefficients in columns 3 through 10)—slightly higher than the 1.12 estimated by MS.

The estimated lag distributions for both the commercial-paper rate and the inflation rate also conform to the MS model of expectations; both indicate that there is a combination of extrapolative and regressive elements in the formation of expectations of future rates. That is, extrapolative elements form expectations when a rise in current rates leads to an expectation of a further rise and vice versa. Regressive expectations hold when the market expects the interest rate to regress toward a "normal" level based on past experience. The relatively high weight on the current values of the commercial-paper rate and inflation rate, followed immediately by lower weights, implies that the market expected some continuation of recent trends followed by a return towards prevailing past levels. In light of these results, we will use the yield on newly issued securities rather than the AAA seasoned corporate-bond rate to represent the long-term rate in the rest of this paper.

Introduction of inflation uncertainty

As noted earlier, the determinants of the risk premium in the basic MS equation are represented by the standard deviation of the commercial-paper rate, while other factors which may be important in determining the risk premium are captured in the constant term or the error term. However, in the spirit of the model, which considers changes in interest and inflation rates separately, we introduce the standard deviation of the rate of inflation over the recent past.

The variation in past inflation rates is intended to account for that portion of the risk premium due to the uncertainty with which market participants view the future course of inflation. We have measured this variation by an 8-quarter moving standard deviation of the rate of change in prices. As noted above, this is the same function used to estimate the uncertainty surrounding the commercial-paper rate. This variable was introduced into the basic model and the results are presented as equation 3, Table 1.

This measure of inflation uncertainty is statistically significant, with a t-statistic of 2.3. The introduction of this determinant of the risk premium reduces the standard error of the equation by a small but statistically significant amount. The inclusion of the inflation uncertainty variable also reduces the value of the constant term, which as we noted above captures some of the risk elements not specifically mentioned in the equation. Once we explicitly introduce the standard deviation of the rate of inflation into the equation, we reduce the importance of the constant term. In addition, some of the risk premium due to inflation uncertainty had been captured by the standard deviation of the commercial-paper rate, and the coefficient of this latter term decreases once inflation uncertainty is expressly considered in the estimation. This was to be expected since changes in the standard deviation of the commercial paper rate had captured changes in the uncertainty with which the market foresees both future real rates of return and rates of inflation. When we introduce the standard deviation of the rate of inflation as a separate determinant, changes in the variation of the commercial paper rate are left to reflect only changes in uncertainty about future real rates of interest. There are only minor differences in the other estimated coefficients.

Inflation uncertainty as risk element?

The significance of the variation in inflation might reflect our economic experience since the mid '60's. Prices and the variation in the rate of inflation have been advancing rapidly since then, which suggests that changes in inflation uncertainty have been only a relatively recent phenomenon in the term-structure risk premium. The model was therefore tested over the shorter time span from 1954.4-1965.4, before the recent rapid advance in prices began.

The term structure equation was estimated without including the standard deviation of the inflation rate as seen in equation 4 in Table 1—and then by including that measure (equation 5). In this earlier period, the fit of the equation is significantly improved when the variation in the inflation rate is included in the explanation of the term structure. The correlation coefficient increases from .90 to .93, and the standard error over the sample period is reduced from 16.0 basis points to 13.6 basis points. Also, the coefficient of the inflation standard-deviation variable is very significant, having a t-statistic of 3.85. Once this inflation risk factor is included, the constant term becomes insignificant. Apparently, during this period, the risk premium in the term structure can be explained basically by two factors—the uncertainty surrounding the future expected course of interest rates and the uncertainty surrounding the future expected rate of inflation.

When we drop the constant term from equation 5, the significance of the two standard-deviation variables increases, as shown in equation 6. The t-statistic for the standard deviation of the commercial-paper rate increases from 1.91 to 2.05, and the significance of the standard deviation of the inflation rate increases from 3.85 to 4.96. These results indicate that, far from being a recent and novel phenomenon, the uncertainty with which the market foresees future expected inflation has been an important determinant of the term structure in the past.

Stability in the term structure equation

Some interesting comparisons are evident between the two overlapping periods. Comparing equations 3 and 5, we note that the coefficient of the standard deviation of the commercial-paper rate shows little change, unlike the standard deviation of the inflation rate. A given change in the standard deviation of the inflation rate commands a higher risk premium during the 1954.4-1965.4 period than over the period as a whole. The constant term also behaves quite differently in the two equations. It is significant over the entire sample period, but insignificant over the shorter period.

This behavior suggests that we may have improperly identified the determinants of the term structure for the 1954.4-1971.2 period with equation 3. Important differences may arise concerning the contribution of some or all of the determinants between the earlier period (1954.4-1965.4) and the later time span (1966.1-1971.2). In testing this hypothesis, we found that a statistically significant difference had occurred between these periods, and that equation 3 failed to portray the changing relationship between the long rate of interest and its determinants.[3]

We also tested equation 2, the basic MS type equation, and found that it failed to pass the statistical test for structural stability for subsets of its coefficients. In particular, for equation 2, we could not accept the hypothesis (at the 5 percent level of significance) that the estimated Almon-distributed lag coefficients for both the commercial-paper rate and the inflation rate remained unchanged over the two periods 1954.4-65.4 and 1966.1-71.2. Hence, neither representation of the term structure—the MS type function (equation 2) or the extended version with an added inflation-uncertainty term (equation 3)—remained unchanged over the full sample period.[4] In short, when one functional relationship is estimated over a span of time, in this case from 1954.4-71.2, it is assumed that the estimated specification remains unchanged in different sub-periods within the entire time span. If this assumption is put in the form of a statistically testable hypothesis, which is then rejected, we can only infer that significant changes have taken place in the estimated relationship between the sub-periods which are not captured in our estimates. We would therefore be misled by the estimated relationship if we used its results to interpret the importance of particular variables in the determination of long-term interest rates for the entire period.

Term structure estimates for 1966.1-71.2

Since statistical tests indicated a significant change had occurred in the term-structure equation between the two periods, 1954.4-65.4 and 1966.1-71.2, we report the term structure estimates for the latter period, also. The results are shown in equations 7, 8 and 9 in Table 1.

First, as mentioned above, the statistical test applied to the MS type equation 2 revealed that a significant difference had occurred between the two sub-periods in the estimates of the distributed-lag coefficients for both the commercial-paper rate and the inflation rate. These differences can be observed by comparing equations 4 and 7. In equation 7, the sum of the weights for the commercial-paper rate is 3.15, while we would expect them to sum to unity, or close to unity, as they did in the earlier period (equation 4). Also in equation 7, the sum of the coefficients for the rate of inflation is –1.5, rather than close to zero as expected. However, none of the estimated coefficients in equation 7 are statistically significant. It appears, therefore, that during the period from 1966.1-71.2, the MS-type specification of the term structure does not support the preferred-habitat model or the MS model of the formation of expectations, although the opposite is true for the earlier estimation period.[5]

Equation 8 reports the results of adding the standard deviation of the inflation rate to the basic MS type equation. We find that the addition of the inflation uncertainty measure adds significantly to the determination of the new-issue corporate-bond rate; the t-statistic of the estimated coefficient is 2.26. The addition of this term has also changed the significance of the current rate of inflation (column 9). The coefficient of the current inflation rate is .147 and its t-statistic is 2.25. Along with the standard deviation of the inflation rate, this is the only other variable which is statistically significant in the determination of the long rate.

We concluded above that the standard deviation of the commercial-paper rate and inflation rate appear to account for the entire term-structure risk premium in the 1954.4-65.4 period. We therefore estimated the term structure model over the 1966.1-71.2 period without the constant term, which was statistically insignificant. The results are reported in equation 9, Table 1. Dropping the constant term leads to an estimated regression more in line with what we would expect. For example, the sum of the lagged coefficients of the commercial-paper rate is closer to unity (1.19) and the sum of the lagged coefficients of the inflation rate closer to zero (–.065) than in the previous two equations. However, the standard deviation of the commercial paper rate remains statistically insignificant in determining the risk premium during this time. These results imply that the term-structure risk premium over the 1966.1-71.2 period was basically due to inflation uncertainty.[6]

Finally, the sample period was ended in 1971.2 because wage and price controls went into effect in 1971.3 and remained in effect until the spring of 1974. Thereafter, prices were materially affected by the oil crisis. One would expect that, after 1971.3, other factors in addition to past history would be material in the determination of prices. Our preliminary results with later quarters included in the sample substantiate this inference. Since we are interested in testing the preferred-habitat model and the model of the formation of expectations, we chose to end the sample period in the second quarter of 1971, as did Modigliani and Shiller.

Conclusions

In this paper, we have reviewed the preferred-habitat model of the term structure. This theory is based upon the hypothesis that the long-term rate of interest is an average of expected future short-term rates plus a risk premium—and that expectations are primarily dependent upon the history of interest rates and rates of inflation over several past years. The major conclusion is that the Modigliani-Shiller specification of this term-structure model can be significantly improved with the introduction of inflation uncertainty as an element determining the risk premium.

We further found that a significant change had occurred in the term-structure equations between the two periods, 1954.4-1965.4 and 1966.1-1971.2. In the earlier period, 1954.4-1965.4, the term-structure risk premium could be accounted for by variables designed to measure the uncertainty surrounding expected future interest rates and inflation rates. However, in the latter period, 1966.1-1971.2, inflation uncertainty remained the only statistically significant determinant of the risk premium. Overall, it appears that uncertainty costs with respect to inflation have been a significant factor in the determination of long-term interest rates since 1954.4.

FOOTNOTES

1. Bibliography given in accompanying column.
2. Holding period refers to the length of time between purchase and sale of a security by an investor, regardless of the maturity.
3. In a recent paper referenced in the bibliography Benjamin Klein addressed the question of whether price changes have been more predictable since the mid-1950's than previously. Klein's data extended back to the 1880's. He concluded that, "although variability in the annual rate of price change is now relatively low, long-term price unpredictability is significant and the uncertainty costs associated with the current inflation no longer seem to be trivial." Our regression estimates are consistent with this conclusion at least as far as we have attempted to measure the impact of changes in inflation uncertainty upon the term structure risk premium.
4. The MS equation 1 was also tested for structural stability over the two periods, 1955.3-65.4 and 1966.1-71.2 and the hypothesis of overall structural stability (Chow test) was rejected at both the 5 and 1 percent levels of significance.
5. Equation 1, the MS equation using the AAA seasoned corporate bond rate as the long rate, was estimated over the 1966.1-71.2 period and only the constant term was statistically significant, with other results similar to those reported in equation 7.
6. Reestimation of equations 7, 8 and 9 to correct for negative serial correlation did not change our conclusions.

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