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EXPECTATIONS, SURPRISES AND TREASURY BILL RATES: 1960-82

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ABSTRACT

Changes in six-month bill rates over semiannual periods in the 1960s and 1970s are successfully related to expected changes and to surprises. The latter include unanticipated changes in expected inflation, in the growth of industrial production and base money, and in inflation uncertainty. Estimation of the basic equation through the middle of 1983 does not suggest any change in structure. Moreover the equation "explains" 60 percent of the extraordinarily high level of real rates since late 1980, largely owing to an excess of unexpected net increases in anticipated inflation over actual increases.

Our estimates provide some support for the expectations theory; there appears to be information content in six-month forward rates. While this content is swamped by the impact of surprises in equations explaining rate changes in terms of forward rates alone, the content is clear when proxies for the surprises are included in the equations.

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The height and volatility of interest rates in the early 1980s spectacularly exceeded that of the past half century. Various researchers have attributed this to: the sharp increase and decline in inflation, the special characteristics of recent monetary (the monetarist experiment) and fiscal (the structural deficit) policies, and mysterious or unidentified forces.[1] The present paper estimates the relationship between the six-month Treasury bill rate and its determinants in the 1960s and 1970s. The purpose is to test various hypotheses regarding interest-rate determination and to determine whether this relationship was altered markedly in the early 1980s.

The short-term bill rate is chosen for investigation for two reasons. First, the yield on a short-term instrument is independent of longer-term expectations regarding inflation, output growth, and fiscal and monetary policies. Longer-term yields should depend heavily on such variables. While reasonably accurate measures of expectations over, say, a six-month horizon can probably be deduced (are, in fact, available from survey data), longer-term expectations are both more uncertain and vary more widely across market participants. Second, analysis of a short-term bill rate allows an easy test of the expectations theory of interest rates. Recent studies by Shiller, Campbell and Schoenholtz (1983) and by Mankiw and Summers (1983) suggest that observed interest rate movements are unrelated to expected changes in rates

[1] See Clarida and Friedman (1982) and Makin and Tanzi (1983) for discussions of these attributions.

extracted from the term structure of short-term rates, calling into question the validity of the expectations theory.[2] The sixth-month bill rate is analyzed because it meshes best with the Livingston survey data.

Our framework draws together two views of interest rate determination: the expectations theory whereby expected changes in the six-month rate can be inferred from the six-month forward rate, and structural models of rates in which unexpected changes can be attributed to unanticipated changes in expected inflation, economic activity, and monetary growth. To anticipate the results, there does not appear to be a marked change in the interest-rate relation in recent years; the 1979-80 rise and 1981-82 decline in the six-month rate are well explained by a reduced-form equation estimated over the 1960-79 period. Further, the expectations theory is supported by the data; when variables explaining unexpected changes in interest rates are included in the estimation equation, the expected rate change performs as anticipated.

The present paper is divided into five broad parts. The first is an examination of real before- and after-tax six-month bill rates in the 1960-82 period; the second presents the framework for the empirical analysis; the third reports the results; the fourth discusses the determinants of the bill rate in the 1980-mid83 period; and the fifth summarizes.

I. Movements in Real Six Month Bill Rates, Before and After Tax

Figure 1 contains plots of the real six-month bill rate, before and after tax. The bill rate is the average of daily figures, on a bond-equivalent basis, for June and December of the years 1960-82, and the expected inflation data are the corresponding numbers for six-month inflation from the Livingston survey. The extraordinarily high level of real bill rates in the

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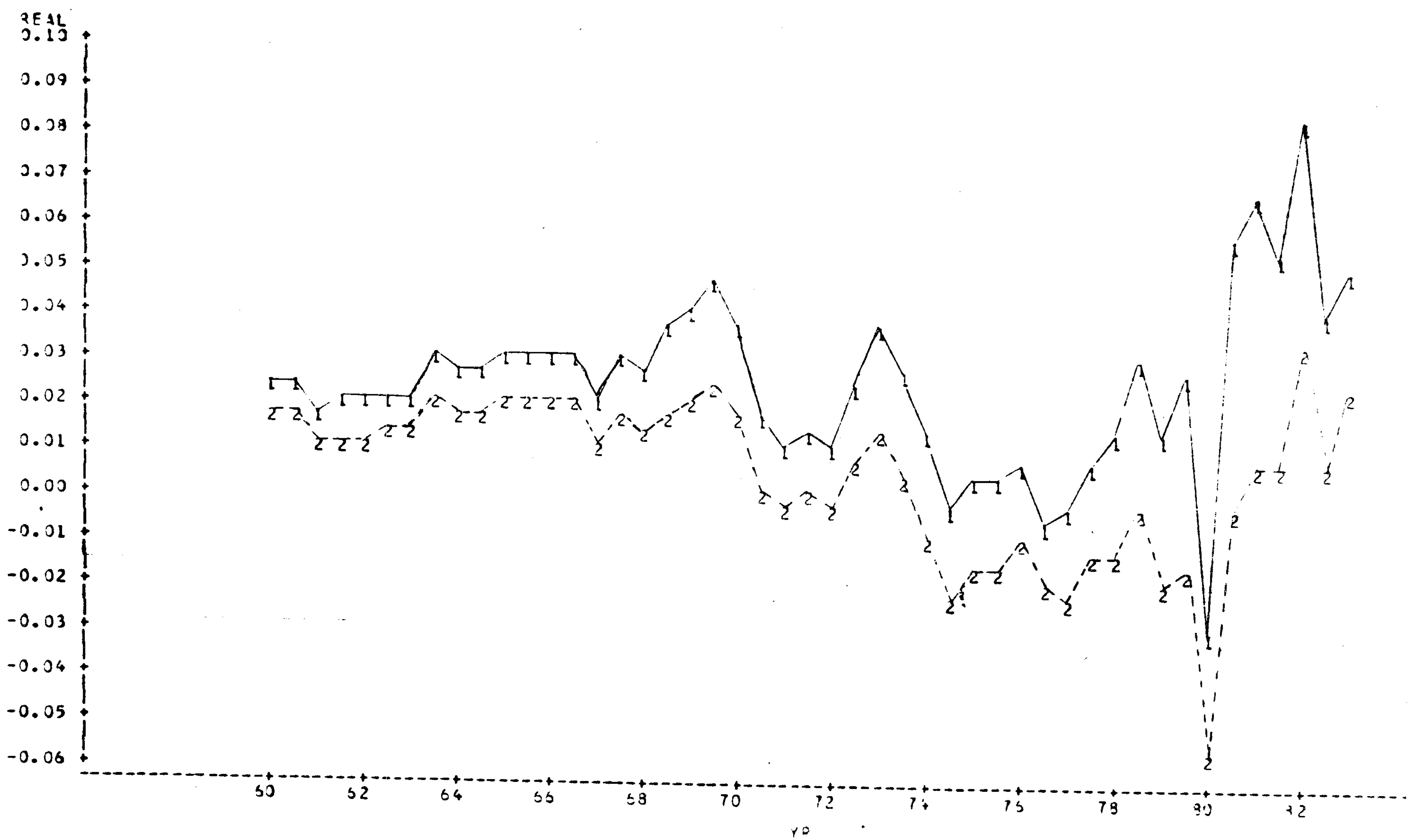
[2] For an alternative view, see Fama (1983).

Figure 1: Real Before and After Tax Six-Month Bill Rates, Semiannually,

June 1960 to June 1982



1980s is obvious. In the five observations from December 1980 to December 1982, the real bill rate averaged 6 percent. This is 4 percentage points higher than the average of the 1960s and 1970s and 4 3/4 percentage points greater than the 1971-79 span.

The appropriate tax rate to employ in a study of real after-tax bill rates is uncertain, and it would probably not be difficult to find economists who would advocate rates as low as zero and as high as the corporate tax rate. For illustrative purposes, we utilize an intermediate rate, a weighted average of marginal personal tax rates for each adjusted gross income class.[3] During the 1960-82 period, this series ranged between 0.24 and 0.38 and averaged 0.30. The June rate is that for the year in which it falls; the December rate is an average of the year in which it falls and the following year.

The after-tax real bill rate, so calculated, tells a far different story than the before-tax real rate. In only one observation in the 1980s is the real after-tax rate above the average in the 1960s. The rate is high in the 1980s only relative to the extraordinarily low rates in the 1970s.

One extreme outlier in both rate series in recent years is worthy of note. The -3 percent real bill rate in June 1980 was 2½ percent below any other observed bill rate in the entire period, and the -5.8 percentage points after-tax real rate was 3½ percentage points below any other. Moreover, the declines from December 1979 were 5½ and 4 percentage points, respectively, and the increases between June and December 1980 were 8½ and 5 percentage points, respectively. The record declines to unprecedented lows and the even sharper immediate reversal cry out for an extraordinary explanation. Fortunately, one is available.

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[3]For details on the construction of this series, see Peek (1983) who kindly made the series available to me.

In response to a sharp increase in the inflation rate in early 1980 from an already high level, President Carter issued an executive order for the Federal Reserve to curb the growth in credit.[4] On March 14, the Federal Reserve implemented a credit controls program which included a noninterest bearing reserve requirement of 15 percent on increases in credit. Apparently as a result, consumer installment credit outstanding contracted at an annual rate of 10½ percent in the April-May period, the first decline since May 1975 and the largest reduction in the postwar era.[5] The program was eased in late May and terminated on July 24, 1980. It is difficult to imagine explaining the sharp, temporary drop in bill rates in the middle of 1980 without explicitly accounting for the credit restraint program.

II. The Conceptual Framework

Our starting point is the tax-adjusted Fisher equation whereby the after-tax nominal rate $[(1-\tau)R]$ to investors equals the after-personal-taxes real rate (r) plus the expected rate of inflation (π):

$$(1-\tau)R = r + \pi. \tag{1}$$

Next is the specification of the determinants of r. A number of small macro models have been utilized to derive real rate relations [Levi and Makin (1979), Melvin (1982), Peek (1982), Wilcox (1983) and Makin and Tansi (1983)].

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[4] The consumer price index accelerated most rapidly and virtually the entire acceleration was due to the inappropriate inclusion of mortgage interest rates in the index. The expected six-month inflation rates given by the Livingston survey for December 1979 and June and December 1980 were 10.1, 10.7 and 10.5 percent, respectively.

[5] <u>Federal Reserve Bulletin</u>, August 1980, p. 634.

The resulting set of determinants depends on both the specified behavioral equations and the substitutions made in deriving the reduced forms. For our purposes, we specify a simple two-equation IS-LM Model:[6]

$$I(\overset{-}{r}, \overset{-}{\tau_b}, \overset{-}{\pi}, \overset{+}{CU}, \overset{-}{\sigma}, \overset{-}{CC}) + X = S(\overset{?}{r}, \overset{+}{Q}, \overset{-}{\frac{M}{P}}, \overset{+}{CC}) + T(\overset{+}{\tau}, \overset{+}{\tau_b}, \overset{+}{Q}) \quad (2)$$

$$L[(\overset{-}{r+\pi}), \overset{+}{Q}, \overset{+}{\sigma}, \overset{+}{M-M^e}] = \frac{M}{P} , \quad (3)$$

where I is a function representing both household and business investment, τ_b is the tax rate on business investment (reflecting the statutory rate, the investment tax credit and depreciation tax schedules for a given inflation rate), CU is the capacity utilization rate, measures uncertainty regarding inflation, CC refers to the 1980 credit controls discussed above, X is real exogenous (defense) demand for output, Q is the supply of real output (production), M is base money, M^e is its expected value, P is the price level, and T is the tax-transfer function. The signs of the partial derivatives are indicated above the arguments in the functions. While most of these are obvious, three merit discussion. First, the hurdle rate for the business component of investment is positively related to business, not personal, tax parameters and to the expected inflation rate (owing to the use of historic-cost depreciation and FIFO inventory accounting). Thus increases in these lower investment and real interest rates [Feldstein and Summers, 1978, and Hendershott, 1981, pp. 913-14]. Second, the impact of greater inflation uncertainty on interest rates is ambiguous; risk-averse investors will require

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[6]Introduction of an aggregate supply equation would introduce supply-shock variables into the specification of the real rate a la Wilcox (1983). Preliminary experimentation with such variables was not promising.

higher nominal returns, but investors in real capital will not be willing to pay such returns (Levi and Makin, 1979, p. 42). Third, the difference between the actual and expected level of base money captures the impact of deviations from money targets on anticipated future monetary policy; above target money generates expectations of a more restrictive policy, lowering the demand for bonds and thus raising the demand for money and interest rates.[7] Solving for r, assuming that the real interest rate effect in the investment function and the output response in the money demand function dominate, yields

$$r = \phi(\overset{+}{Q}, \overset{+}{CU}, \overset{+}{X}, \overset{-}{\pi}, \overset{-}{CC}, \overset{+}{M-M^e}, \overset{?}{\sigma}, \overset{-}{\tau_b}, \overset{-}{\tau}). \qquad (3')$$

Substitution of (3') into (1), first-differencing, using the relation $\Delta[1-\tau)R] = (1-\tau)\Delta R - R_{-1}\Delta\tau$, and solving for the change in the nominal rate leads us to the following linear approximation:

$$\Delta R = \frac{\phi_1 + \phi_2}{1-\tau}\%\Delta Q + \frac{\phi_3}{1-\tau}\%\Delta X + \frac{1-\phi_4}{1-\tau}\Delta\pi + \frac{\phi_5}{1-\tau}\Delta CC + \frac{\phi_6}{1-\tau}U\%\Delta M + \frac{\phi_7}{1-\tau}\Delta\sigma$$

$$+ \frac{\phi_8}{1-\tau}\Delta\tau_b + \frac{R_{-1} + \phi_9}{1-\tau}\Delta\tau + \varepsilon, \qquad (4)$$

where the ϕ's have the same signs as the partials of the ϕ function (changes in the Q and CU variables are combined in the $\%\Delta Q$ term), $U\%\Delta M$ is the unexpected percentage change in M, and ε is a stochastic error term.

[7] Makin (1982) notes that positive money surprises tend to lower interest rates by raising output and saving and to raise rates by raising expected inflation. Because current output and expected inflation are represented in the model, these effects are already incorporated.

Conceptually, the change in the interest rate and in all the other variables can be partitioned into expected and unexpected components. The total change in the interest rate then equals the expected change plus the unexpected parts of the terms on the right-hand side of (4).[7a] Given the six-month time frame considered here, it seems reasonable (and is certainly convenient) to assume that tax rate and defense expenditures changes are largely anticipated owing to the lags between the known intent of future legislation and the actual implementation.[8] On the other hand, changes in inflation uncertainty and the credit controls are, almost by definition, fully unexpected. Thus only the output and inflation terms are viewed as having both expected and unexpected components. With these assumptions, we can write

$$\Delta R = \emptyset_o E\Delta R + \frac{\emptyset_1 + \emptyset_2}{1-\tau} U\%\Delta Q + \frac{1-\emptyset_4}{1-\tau} U\Delta\pi + \frac{\emptyset_5}{1-\tau}\Delta CC + \frac{\emptyset_6}{1-\tau} U\%\Delta M + \frac{\emptyset_7}{1-\tau}\Delta\sigma + \varepsilon_U, \qquad (5)$$

where an E denotes the expected change and U the unexpected change, and $\emptyset_o$ should be unity.

There are two advantages to estimating equation (5) rather than (4). First, the expectations theory of the term structure can be tested directly. A strong test is that $\emptyset_o$ is both significantly greater than zero and not

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[7a]Let E denote the expected change and U the unexpected change. Then differencing of (1) yields:

$$\Delta[(1-\tau)R] = E\Delta(r+\pi) + U\Delta(r+\pi)$$

$$(1-\tau)\Delta R - R_{-1}\Delta\tau = (1-\tau)E\Delta R - R_{-1}E\Delta\tau + U\Delta(r+\pi)$$

$$\Delta R = E\Delta R + R_{-1}U\Delta\tau/(1-\tau) + U\Delta(r+\pi)/(1-\tau).$$

[8]The "causality" of this sentence is somewhat misleading. As noted earlier, a short-term bill rate was selected for analysis in part so that this assumption would be reasonable.

significantly different from unity, i.e., forward rates have informational content and the data are not inconsistent with the pure theory. The individual parts of the hypothesis constitute weak tests. Second, the measurement of τ and τ_b is less important for the estimation of (5) than of (4). The principal effect of change in taxes on ΔR comes through the $\Delta\tau$ and $\Delta\tau_b$ terms which do not appear in (5).

II. The Estimates

A. The Data

The dependent variable is the observed percentage change in the monthly average (June and December) of daily six-month bill rates calculated on a bond-equivalent annual basis. The change that was expected is the difference between the value expected six months earlier [$E_{-1}(R)$] and the value six months ago (R_{-1}). This change is assumed to be the forward rate -- computed from last period's one (six month) and two (twelve month) period bill rates -- plus a constant:

$$E_{-1}(R) = 2\left[\frac{1 + R2_{-1}}{1 + R_{-1}/2} - 1\right] + e_o,$$

where R2 is the twelve-month bill rate.[9]

The unexpected change in the expected six-month inflation rate is the difference between the observed change and that expected, $E\Delta\pi = E_{-1}(\pi) - \pi_{-1}$, where $E_{-1}(\pi)$ can be computed analogously to $E_{-1}(R)$ from inflation rates over

[9] Following Mishkin (1982), the difference between the expected and forward rates was hypothesized to depend on interest-rate uncertainty. When this was approximated by our measure of inflation uncertainty (see below), the measure had a coefficient very near zero.

the next six and twelve months that were expected six months ago. These data are based on Livingston's survey.[10]

For the output variable, we use industrial production because it is available monthly and forecasts of six-month changes in it can be derived from the Livingston survey. The unexpected percentage change is computed as

$$U\%\Delta Q = \frac{IP - E_{-1}(IP)}{IP_{-1}},$$

where IP is the level of the industrial production index during the last month (June or December) of the period.

Following Levi and Makin (1979) and Makin and Tanzi (1983), the change in the standard deviation of expected six-month inflation is assumed to be linearly related to the change in the standard deviation of the expectations of Livingston survey respondents.

To my knowledge, there are no available appropriate survey measures of anticipated monetary growth. Two variables were tested: the actual growth rates during the previous one and two years. For the monetary variable, the adjusted monetary base computed by the Federal Reserve Bank of St. Louis was employed. Because the results were very similar, we only report equations in which unanticipated monetary growth defined as the difference between the growth rate during the current semiannual period and the average growth rate in the previous two years.

The consumer-credit-control variable is defined as plus one in June 1980, minus one in December 1980, and zero elsewhere.

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[10]These data and all others based on the Livingston survey were kindly supplied by Donald Mullineaux of the Federal Reserve Bank of Philadelphia.

B. Estimates for 1960-79

Daily-average bill-rate data first became available in 1960. Thus the maximum estimation span is the end of 1960 to the end of 1982 or 45 semiannual observations. Equations (1.1)-(1.4) in Table 1 are estimated on data prior to the gyration of rates in 1980 and the high levels of late 1980 through the middle of 1982.[11] In (1.1), only the expected change in the bill rate is employed as a regressor. Equations (1.2)-(1.4) are estimates of equation (5) utilizing different specifications of τ, the marginal-tax rate on personal interest income. In (1.2), the tax rate is assumed to be constant, and the constant value is embedded in the coefficients on all variables except the expected change in rate. In (1.3), Peek's estimate of τ, discussed earlier is employed. In (1.4), an estimate of τ is extracted from Salomon and Hutzler yields on six-month Treasury bills and prime tax-exempt securities, the estimate being 1 less the ratio of the exempt to taxable yields for the first day of the relevant month.

The near zero coefficient on the expected change in rate in (1.1) is consistent with the recent results of Shiller et al (1983) and Mankiw and Summers (1983). Note, however, that the coefficient is not measured with precision; the estimate is not significantly different from 0.8, although it does differ from unity. When unexpected changes in expected inflation, industrial production, and base growth (as well as the change in the standard deviation of expected inflation) are added to the equation to capture some of unexpected changes in interest rates [see equation (1.2)], the coefficient on the expected percentage change in rate becomes significantly greater than zero at the 0.05 level and within a standard error of unity. The coefficients on

[11] In these equations all variables, including the constant term, have been divided by R_{-1} in order to reduce heteroscedasticity of the residuals.

Table 1: Explanation of Six-Month Changes in the Six-Month Bill Rate[a/]

	Period	Constant	Expected ΔR	Unexpected $\Delta\pi$	Unexpected $\%\Delta IP$	Unexpected $\%\Delta M$	Inflation Uncertainty (times 10^4)	Consumer Credit Cont.	R^2	DW	SEE
(1.1)	602-792	.0023 (.0019)	.015 (.390)						.097	1.80	.168
(1.2)	602-792	-.0006 (.0019)	.720 (.374)	.738 (.259)	.0746 (.0339)	.132 (.149)	.523 (.429)		.424	2.22	.142
(1.3)	602-792[b/]	-.0006 (.0019)	.710 (.372)	.518 (.180)	.0547 (.0244)	.098 (.108)	.364 (.305)		.426	2.23	.142
(1.4)	602-792[c/]	-.0007 (.0019)	.772 (.375)	.436 (.138)	.0402 (.0183)	.079 (.082)	.316 (.237)		.431	2.21	.141
(1.5)	602-831	-.0006 (.0017)	.665 (.334)	.708 (.229)	.0802 (.0326)	.173 (.139)	.589 (.419)	-.0587 (.0102)	.705	2.36	.143

[a/] Standard errors of the regression coefficients are in parentheses beneath the coefficients. All variables were deflated by the lagged value of the six-month bill rate to reduce heteroscedasticity of the residuals. The summary statistics thus are relevant to $\Delta R/R_{-1}$.

[b/] All regressors except the constant and the expected change in the interest rate have been divided by 1 minus the weighted-average marginal personal tax rate (see text).

[c/] All regressors except the constant and the expected change in the interest rate have been divided by the ratio of tax-exempt to taxable six-month yields (see text).

the inflation and economic-activity variables are also significantly greater than zero; the coefficients on the change in inflation uncertainty and the money surprise are about a standard error greater than zero.

Comparison of equations (1.3) and (1.4) with (1.2) reveals only minor differences. Because $1-\tau$ is embedded in the coefficients in (1.2) -- except the constant and that on $E\Delta R$ -- the other coefficients in (1.3) and (1.4) must be divided by the respective mean values of $1-\tau$ to make them comparable to (1.2) and to each other. These means are 0.70 and 0.57. When this division is made, no coefficient in (1.3) or (1.4) differs from its counterpart in (1.2) by as much as 7½ percent. Moreover, the explanatory powers of the three equations are virtually identical. (This contrasts with Peek's finding that division by $1-\tau$ significantly improves the fit.) Given the uncertainty regarding the correct measurement of τ, this does not seem surprising.

Equation (1.5) in Table 1 extends the estimation period through the middle of 1983. The coefficients exhibit remarkable stability in face of the unprecedented changes in interest rates in the 1980-mid83 period; as does the equation standard error. The measured increase in explanatory power is attributable entirely to the ability of the consumer-credit dummy to capture the sharp seesaw in the bill rate in 1980. To test for a change in structure, a zero-one dummy variable assuming the one value after 1979 was interacted with the three significant variables: $E\Delta R$, $U\Delta\pi$ and $U\%\Delta Q$. The t- ratios on these three variables ranged from 0.1 to 0.6 and the equation standard error increased.

C. The Impact of the Explanatory Variables, 1960-82

Expected increases in the six-month bill rate never exceeded a full percentage point in the 1960-82 span, but they were in the 65-100 basis point range in 13 semiannual periods. While declines were larger than 65 basis points in only four periods, these include nearly one and a half and over two percentage point expected declines in the first halves of 1980 and 1981. The 0.72 estimated coefficient in equation (1.2) of Table 1 suggests that 72 percent of these expectations were translated into actual movements.

The estimates and underlying data imply some major impacts of unanticipated changes in expected inflation. Substantial unanticipated increases occurred following the oil price shocks, raising the bill rate by 3 percentage points in 1973-74 and by nearly 5 points in 1979-80. In contrast, the bill rate fell by a full percentage point in the first half of 1975 and by nearly 4½ points in 1981-mid83 because of unanticipated declines in expected inflation.

Unanticipated industrial-production growth (or decline) also had substantial effects on the bill rate over parts of the 1960-82 period. The unexpectedly strong recovery following the Kennedy-Johnson tax cuts in the early 1960s raised the bill rate by 1 and 3/4 percentage points in the 1963-66 span. Similarly, the surprisingly strong rebound from the middle of 1980 to the middle of 1981 increased the bill rate by nearly a percentage point. On the other hand, the unexpectedly sharp declines in output from the middle of 1973 to the middle of 1975 and from the middle of 1981 to the end of 1982 lowered the bill rate by 1 1/4 and 1 3/4 percentage points, respectively.

Monetary surprises and changes in inflation uncertainty have not had as large impacts on the bill rate as have the other variables. Most importantly, the increased uncertainty accompanying the rise in inflation in the 1973-mid74 and 1978-mid81 periods each raised the bill rate by about 3/4 of a percentage point. The subsequent declines in uncertainty lowered the rate by somewhat less. Positive money surprises increased the bill rate by about 40 basis points in the early 1960s, in 1967-68 and in 1977-mid78; negative surprises lowered the rate by a like amount in 1969-mid70 and 1981.

III. The Recent Experience

The actual and forecasted changes in the bill rate for semi-annual segments of the 1980-mid83 period are reported in Table 2. The forecasts are based upon equation (1.2). As can be seen in column 3, there are large, nearly offsetting, forecast errors in the first and second halves of 1980 (owing to the imposition and removal of credit controls); the equation underforecasts by a percentage point in 1981 (the forecasted decline is 4 1/2 percentage points, not the 3 1/2 observed); large, somewhat offsetting errors occur in 1982 (the equation forecasts a roughly continuous decline, rather than the observed increase and then sharp decline); and about half of the rise in early 1983 is forecast. Given the offsetting nature of the errors, the cumulative error on the level of the bill rate (indicated in column 4 of Table 1) is small. By late 1982 and early 1983, the forecasted bill rate was less than a percentage point below the actual.

Table 3 indicates the sources of the rise and fall in the bill rate between June 1978 and June 1983. Eighty percent (6.70 percentage points) of the 8.42 increase to December 1980 is explained by the equation. Over 5 points is due to unexpected increases in anticipated inflation, two-thirds of a point to unexpected increases in output, a half point to the increase in inflation uncertainty and a third point to other factors. Because the expected inflation rate rose by only 4.1 percentage points, the real interest rate increased by 4.3 percentage points. Of this rise the estimated equation

Table 2: Actual and Forecasted Bill Rate Changes, 1980-mid83
(percentage points)

		Actual	Forecast [Equ. (2)]	Actual -Forecast	Cumulative Difference
1980	1	-5.08	0.22	-5.30	
	2	8.34	2.28	6.06	0.76
1981	1	-0.65	-1.89	1.24	2.00
	2	-2.98	-2.68	-0.30	1.70
1982	1	1.36	-1.25	2.61	4.31
	2	-5.13	-1.36	-3.77	0.54
1983	1	0.81	0.36	0.45	0.99

Table 3:

The 1978-82 Interest Rate Cycle

		June 78 - Dec. 80	Dec. 80 - June 83
Change in Rate		8.42	-6.59
Due to:	Unexpected Change in Expected Inflation	5.16	-4.38
	Unexpected Change in Industrial Production	0.66	-1.25
	Change in Inflation Uncertainty	0.53	-0.37
	Other (largely expected change in the rate)	0.35	-0.81
	Total	6.70	-6.81
Unexplained Change		1.72	-0.22

explains 2.6 (6.7 - 4.1) points or sixty percent. The estimated relationship also explains 60 percent of the extraordinarily high average real bill rates in the early 1980s.[12]

One and a half percentage points of the 2.6 percentage-point explained increase in the real bill rate can be attributed to the unanticipated increases in industrial production, inflation uncertainty and other factors noted above. However, the primary single factor contributing to the rise was unexpected increases in inflation far in excess of the actual 4.1 percentage point increase. From mid1978 to mid1979, no increase was expected, but a two point rise occurred. From late 1979 to late 1980 half point increases were anticipated, while the actual expected rate rose by another two points. In total, the cumulated unexpected increase in anticipated inflation over this span was a full 7 percentage points.[13] Even though the estimated coefficient on expected inflation increases is only 0.74, implying that the nominal bill rate rises by only three-quarters of a point for every point of unanticipated increase in inflation, the forecasted nominal bill rate rises by 5.2 points because of this 7 point increase and thus the real bill rate rises by over a full point.

Between the end of 1980 and the middle of 1983, the bill rate declined

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[12] It was noted in Section I that the real six-month bill rate was 4 3/4 percentage points too high, relative to the 1970s, for the 5 observations from 802 to 822. The average cumulative forecast error for our equation for those periods is a little under 2 percentage points, indicating that only 40 percent of the high average value need be attributed to unidentified factors.

[13] These large errors are not surprising given the second oil price shock and the nearly 4 percentage point increase in home mortgage rates, both of which heavily influenced the CPI, during this period. A crude measure of inflation surprises is the difference between the all-items CPI and the all-items less food, energy and home purchase and finance, the excluded items being difficult to predict (especially when an oil shock occurs). For 1978, 1979 and 1980, this difference was 2.1, 5.8 and 2.5 percentage points, respectively.

over 6 1/2 percentage points. This decline, which was almost entirely a fall in nominal rates (expected inflation decreased by 6.2 percentage points), is fully explained by our estimation equation. All the factors that contributed to the early increase in rates reversed themselves, inducing the decline. Unexpected declines in industrial production, inflation uncertainty, and the catch-all other tended to lower the real rate by almost 2 1/2 percentage points, but rough equality between unexpected and actual declines in inflation, along with the only partial (0.74) response of nominal rates to unexpected changes in inflation, tended to raise the estimated real rate, resulting in virtually no change.

At this point, one might ask about the impact of the unprecedented federal deficits. A simple response is that deficits were not unprecedented through the period analyzed. From mid1981 to mid1982, the high-employment deficit was only $12 billion or 0.3 percent of high-employment GNP. In the year mid1982 to mid1983, this deficit jumped to $48 billion, but the ratio to high employment GNP, 1.1 percent, was still no greater than in 1975. High-employment deficits have been large only since the third year of the personal tax cut went into effect in July 1983.[14] Thus there is no reason to believe that short-term Treasury rates were high in the 1981-mid83 period because of the deficits. On the other hand, short-term rates could now (1984) be higher than they would be in the absence of the structural deficit.[15]

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[14] Von Furstenburg (1981) has documented a systematic tendency for lawmakers to cut taxes during recessions and generally run large high-employment deficits in early stages of economic recoveries.

[15] Hendershott and Shilling (1982) calculated that the ERTA of 1981 could raise real interest rates by nearly two percentage points in the new equilibrium owing to higher steady-state business investment. For an analysis suggesting that the cummulation of deficits raised three-year Treasury rates in 1983, se deLeeuw and Holloway, 1983.

IV. Summary

Changes in six-month bill rates over semiannual periods since 1960 have been successfully related to expected changes and to surprises. The latter include unanticipated changes in expected inflation, in the growth of industrial production and base money, and in inflation uncertainty, as well as the imposition and removal of consumer credit controls in 1980. Surprise revisions in inflation expectations had large effects (3 to 5 percentage points) and errors in forecasts of industrial-production growth had moderate impacts (1 to 2 percentage points) on the six-month bill rate in a number of periods. Monetary-growth surprises and changes in inflation uncertainty had smaller positive impacts.

Our estimates provide support for the expectations theory; there is information content in forward rates. While this content is swamped by the impact of surprises in equations explaining rate changes in terms of forward rates alone, the content is clear when proxies for the surprises are included in the equations.

Real six-month bill rates rose by over 4 percentage points between June 1978 and December 1980 and averaged 4 3/4 percentage points more in 1981 and 1982 than they did in the 1970s. Forecasts from a reduced-form equation estimated over the 1960-79 period "explain" sixty percent of both the increase and the high 1981-82 average. The primary cause of the high real rates is the asymmetry between increases and decreases in unexpected changes in anticipated inflation relative to observed changes. Between June 1978 and December 1980, unexpected increases exceeded observed by 3 percentage points (7 versus 4). Between December 1980 and June 1983, unexpected and observed declines were roughly equal (6 1/4 percentage points). The estimation equation also explains the full 7 1/2 percentage point decline in the nominal six-month rate during 1981 and 1982, although rates did not come down as rapidly as the equation predicts.

The current paper tells only part of the recent interest rate story. The full story requires the modeling of expected changes in all the variables utilized in this study: the bill rate itself, anticipated inflation, industrial production growth, monetary growth, tax rates and expenditures policies. This is an agenda for future research.

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