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# TERM PREMIUMS AND DEFAULT PREMIUMS IN MONEY MARKETS

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There are time-varying term and default premiums in the expected returns on money market securities. Default premiums decline with maturity and tend to be higher during recessions. Term premiums tend to increase with maturity during good times, but humps and inversions in the term structure of expected returns are common during recessions. Treasury bills produce positive average term premiums for the overall sample, but average term premiums for private-issuer securities are close to 0.0. A general conclusion is that variation in forward rates is primarily variation in current expected returns rather than in forecasts of changes in interest rates.

## 1. Introduction

There are many studies of the Treasury bill term structure. For example, Roll (1970), Startz (1982), and Fama (1984b, c) document time-varying term premiums in the expected returns on longer-term bills. There is little work on the term structure for private-issuer money market securities like commercial paper, bankers' acceptances (BA's), and negotiable certificates of deposit (CD's). There is no reason to presume that the expected returns on such short-term private-issuer securities are in lock step with expected returns on bills. Private-issuer securities have default risks that can put a wedge between their expected returns and those on bills. The wedge can vary through time if, for example, default risks are higher during recessions.

This paper compares expected returns on bills and private-issuer money market securities. The tests produce strong evidence of time-varying default premiums in the expected returns on private-issuer securities and time-varying expected term premiums for all maturities of all securities. Expected term and default premiums are related to the business cycle. Expected default premiums

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tend to be higher during recessions. Expected term premiums tend to increase with maturity when business activity is strong, but humps and inversions in the term structure of expected returns are common during recessions.

The examination of term and default premiums produces challenging evidence for eventual explanation by term structure models.

(a) Term premiums are generally interpreted as rewards for risk. In this view, the changes from upward-sloping term structures of expected returns during good times to humped and inverted term structures of expected returns during recessions imply that the ordering of risks and rewards across maturities changes with the business cycle and is not always monotonic.

(b) Contrary to intuition and the model in Merton (1974), expected default premiums decline with maturity. Moreover, longer-maturity default premiums increase less during recessions than shorter-maturity default premiums. Thus, humped term structures of expected bill returns during recessions often coincide with inverted term structures of private-issuer expected returns.

(c) The recession inversions of the private-issuer term structure balance out positive expected term premiums during good times. For long time periods, average term premiums on private-issuer securities are close to 0.0. This is in contrast to the positive average term premiums observed on bills.

A general conclusion, underlying many of the specific conclusions outlined above, is that variation in time $t$ forward rates is primarily variation in time $t$ expected holding period returns. To a good approximation, the forward rate calculated from the current (time $t$) prices of $x$- and $y$-month securities,[1]

$$f(x, y:t) = \ln P(y:t) - \ln P(x:t), \tag{1}$$

is the expected return if the $x$-month security is bought now and sold later when it has $y$ months to maturity,

$$\mathrm{E}_t h(x, y:t+x-y) = \mathrm{E}_t \ln P(y:t+x-y) - \ln P(x:t). \tag{2}$$

In other words, the data are approximately consistent with a model in which the term structure of current prices (or interest rates) is the best forecast of future term structures, so that expected holding period returns can be inferred from current prices. Viewed a bit differently, the conclusion that forward rates are just current expected holding period returns implies that forward rates have little power to forecast changes in interest rates.

[1] Symbols up to a colon indicate the nature of a variable, for example, the $(x-y)$-month return, $h(x, y:)$, the $(x-y)$-month forward rate, $f(x, y:)$, and the price of an $x$-month security, $P(x:)$. Symbols after the colon indicate the date when the variable is observed, which is always either $t$ or $t+x-y$.

To motivate the analysis, I first present some descriptive evidence on the relations between average forward rates and average returns. Next, the regression technique in Fama (1984a, b) is used to examine the split of forward rates between time-varying expected returns and forecasts of future interest rates. Plots then detail the cyclical behavior of expected term and default premiums. Finally, a trading strategy is used to provide a different perspective on the information in forward rates about expected returns.

## 2. Some motivating evidence on forward rates and expected returns

The data are beginning-of-month secondary market quotes from the Salomon Brothers *Analytical Record of Yields and Yield Spreads*. Quotes are available from January 1967 to January 1985 for one-, three-, and six-month bills, prime-quality (rated A1–P1) commercial paper, prime-quality bankers' acceptances (BA's), and prime-quality certificates of deposit (CD's). Quotes for twelve-month CD's and bills are available from November 1971 to January 1985. There is one default (Penn Central) on A1–P1 commercial paper during the sample period, and there are no defaults on prime BA's and CD's.

### *2.1. Average returns and forward rates for the overall sample*

Table 1 shows means of returns and forward rates for bills and CD's with maturities up to twelve months. All variables are annualized continuously compounded percent returns – a convention followed throughout the paper. Thus, variables that cover different return periods (one, two, three, or six months) are in the same units. Variables are labeled in terms of the transactions they imply. For example, the three-month return obtained by buying a six-month security now (time $t$) and selling it at three months to maturity,[2]

$$h(6,3:t+3) = \ln P(3:t+3) - \ln P(6:t), \tag{3}$$

is labeled B6/S3. Likewise, the three-month forward rate calculated from the current prices of six- and three-month securities,

$$f(6,3:t) = \ln P(3:t) - \ln P(6:t), \tag{4}$$

is labeled B6/S3. This labeling of forward rates fits the simple term structure model in which the three-month forward rate calculated from the time $t$ prices of six- and three-month securities is $\mathrm{E}_t h(6,3:t+3)$, the expected B6/S3 return from buying a six-month security at time $t$ and selling it in three months.

[2] Bills, commercial paper, and BA's pay no interest. CD's issued with a year or less to maturity have one interest payment at maturity. Thus, definitions of returns and forward rates can be in terms of prices, with the interest payment on CD's included as part of the final price.

Table 1

Means of annualized percent returns (Ret.) and forward rates (Fwd.) for bills and certificates of deposit (CD's) with maturities to twelve months; November 1971 to July 1984.[a]

| | All months, $N = 153$ | | | | Humped months, $N = 90$ | | | | Monotone months, $N = 63$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bills | | CD's | | Bills | | CD's | | Bills | | CD's | |
| | Ret. | Fwd. | Ret. | Fwd. | Ret. | Fwd. | Ret. | Fwd. | Ret. | Fwd. | Ret. | Fwd. |
| *Holding period returns and forward rates* (B$x$/S$y$ means buy at maturity $x$ and sell at $y$) | | | | | | | | | | | | |
| B1/S0 | 7.85 | 7.85 | 9.04 | 9.04 | 9.36 | 9.36 | 11.00 | 11.00 | 5.69 | 5.69 | 6.25 | 6.25 |
| B3/S1 | 8.40 | 8.43 | 9.17 | 9.21 | 10.00 | 10.02 | 11.07 | 11.11 | 6.11 | 6.16 | 6.46 | 6.51 |
| B6/S3 | 8.77 | 8.89 | 9.17 | 9.29 | 10.30 | 10.39 | 10.78 | 10.87 | 6.57 | 6.75 | 6.86 | 7.04 |
| B12/S6 | 8.53 | 8.75 | 8.83 | 9.05 | 9.85 | 9.98 | 10.07 | 10.17 | 6.63 | 6.99 | 7.06 | 7.45 |
| *Term premiums* (B$x$/S$y$ return or forward rate minus B1/S0 return) | | | | | | | | | | | | |
| B3/S1 | 0.55 | 0.58 | 0.13 | 0.17 | 0.64 | 0.67 | 0.07 | 0.11 | 0.41 | 0.46 | 0.21 | 0.26 |
| B6/S3 | 0.92 | 1.04 | 0.12 | 0.25 | 0.94 | 1.04 | −0.22 | −0.13 | 0.88 | 1.05 | 0.61 | 0.79 |
| B12/S6 | 0.68 | 0.90 | −0.21 | 0.01 | 0.50 | 0.63 | −0.93 | −0.83 | 0.93 | 1.30 | 0.81 | 1.20 |
| *Default premiums* (B$x$/S$y$ private minus B$x$/S$y$ bill return or forward rate) | | | | | | | | | | | | |
| B1/S0 | | | 1.20 | 1.20 | | | 1.64 | 1.64 | | | 0.56 | 0.56 |
| B3/S1 | | | 0.78 | 0.78 | | | 1.07 | 1.08 | | | 0.35 | 0.35 |
| B6/S3 | | | 0.40 | 0.40 | | | 0.48 | 0.48 | | | 0.29 | 0.29 |
| B12/S6 | | | 0.30 | 0.30 | | | 0.22 | 0.19 | | | 0.43 | 0.46 |

[a] Dates are purchase dates for returns and quote dates for forward rates. Since the last quote date is January 1985, the purchase date for the last B12/S6 return for bills or CD's is July 1984. To facilitate comparisons July 1984 is the last purchase date used for all returns and forward rates. The 90 humped term structure months are December 1972 to February 1975 and April 1978 to June 1983. The 63 monotone (increasing) term structure months are November 1971 to November 1972, March 1975 to March 1978, and July 1983 to July 1984 (the last month for a B12/S6 return).

For both bills and CD's, term structures of average returns replicate term structures of average forward rates. For example, in the means for the total sample, the average B12/S6 return from buying a twelve-month bill (or CD) and selling it at six months to maturity is less than the average B6/S3 return from buying a six-month bill (or CD) and selling it at three months to maturity. The average forward rates for B12/S6 are likewise less than for B6/S3. In the means for the total sample, the difference between the average bill or CD return for a given B$x$/S$y$ maturity combination and the average B$x$/S$y$ forward rate is never greater than 0.23 percent per year and is 0.13 percent or less in four of six cases. In results (not shown) for the longer sample period for bills, BA's, CD's, and commercial paper with maturities up to six months, the differences between average returns and average forward rates are 0.06 percent per year or less for the B6/S3 maturity combination and 0.02 percent per year (two basis points) or less for B3/S1.

Table 1 also shows average default premiums in CD returns and forward rates. A default premium is defined as the difference between the CD return (or forward rate) for a given combination of buy and sell maturities (B$x$/S$y$) and the contemporaneous bill return (or forward rate) for the same B$x$/S$y$ combination. In the results for the total sample, average CD default premiums calculated from forward rates are within one basis point of average default premiums calculated from returns. Average forward-rate default premiums for BA's and commercial paper (not shown) are also within one basis point of average default premiums calculated from returns.

### 2.2. *Subsample average returns and forward rates*

The hypothesis that time $t$ B$x$/S$y$ forward rates are time $t$ B$x$/S$y$ expected returns predicts that average returns increase with maturity when forward rates increase with maturity, but term structures of average returns will be humped or inverted when forward-rate term structures are humped or inverted. In contrast, the premise of the liquidity preference hypothesis [see, for example, Kessel (1965)] is that expected returns always increase with maturity, so that humped or inverted term structures reflect market forecast of declines in future yields. The liquidity preference hypothesis predicts that average returns increase with maturity when forward-rate term structures are humped or inverted as well as when forward rates increase with maturity.

Table 1 shows average returns and forward rates for months of 'humped' and 'monotone' term structures. The humped sample is the 90 months of December 1972 to February 1975 and April 1978 to June 1983 that include almost all non-increasing forward-rate term structures for bills or CD's. The monotone sample is the 63 months of November 1971 to November 1972, March 1975 to March 1978, and July 1983 to July 1984 (the last purchase month for a B12/S6 return) that include almost all monotone increasing forward-rate term structures.

The subsample results support the hypothesis that time $t$ B$x$/S$y$ forward rates are just time $t$ B$x$/S$y$ expected returns. When forward rates increase with maturity, subsequent average returns also increase with maturity. More interesting, for the months when the forward-rate term structure is humped, term structures of average returns are also humped, and the humps in average returns occur at the same maturities as the humps in average forward rates. For the humped months, average returns and average forward rates on bills increase across the B1/S0, B3/S1, and B6/S3 maturity combinations, but the average return and average forward rate for B12/S6 are less than for B6/S3. For CD's the average B3/S1 forward rate for the humped months is slightly greater than the average one-month CD rate (B1/S0), but the average B6/S3 and B12/S6 forward rates are both less than the average one-month rate. The same ordering is observed for average returns, and the average CD return for a given B$x$/S$y$ maturity combination never differs from the average B$x$/S$y$ forward rate by more than 0.10 percent (ten basis points) per year.

The evidence that average returns replicate the structure of average forward rates when forward-rate term structures are humped and when forward rates increase with maturity suggests that B$x$/S$y$ forward rates are largely just B$x$/S$y$ expected returns. This suggestion is now examined more precisely.

## 3. Regression tests

The regressions require a detailed term structure notation that accommodates the availability of quotes for one-, three-, six-, and twelve-month maturities. The notation maintains the B$x$/S$y$ intuition.

### *3.1. The components of multi-month forward rates*

The time $t$ price of a $y$-month security that pays \$1 at $t+y$ can be expressed as

$$P(y:t) = \exp -r(y:t), \tag{5}$$

where $r(y:t)$ is the yield to maturity on the security. The price of an $(x>y)$-month security of the same type can then be expressed in terms of the yield $r(y:t)$ and an $(x-y)$-month forward rate, $f(x,y:t)$,

$$P(x:t) = \exp[-r(y:t) - f(x,y:t)]. \tag{6}$$

Eqs. (5) and (6) are attractive because they express prices in terms of observable discount rates. However, most equilibrium models of the term structure hypothesize that the price of a security is determined by forecasts of equilibrium expected returns over the life of the security. An expression for the price of an $x$-month security in the spirit of such models is

$$P(x:t) = \exp[-\mathrm{E}_t h(x,y:t+x-y) - \mathrm{E}_t r(y:t+x-y)], \tag{7}$$

where $E_t h(x, y: t+x-y)$ is the $Bx/Sy$ equilibrium expected return on the security from $t$ to $t+x-y$, and $E_t r(y: t+x-y)$ is the time $t$ market forecast of the yield on the security to be observed at $t+x-y$. The expected values $E_t$ are assumed to be efficient or rational, which means they are the best possible assessments given the information available at $t$.

Substituting (7) and (5) into the forward-rate definition (1) gives

$$f(x, y: t) = E_t h(x, y: t+x-y) + [E_t r(y: t+x-y) - r(y: t)]. \tag{8}$$

In words, when the price $P(x: t)$ is viewed as in (7), the forward rate is the expected return on the security from $t$ to $t+x-y$, plus the expected change from $t$ to $t+x-y$ in the $y$-month yield. Thus, (8) says that the forward rate can potentially reveal information about the current $Bx/Sy$ expected return, the expected change in the $y$-month yield $x-y$ months ahead, or both. This observation is central in the tests.

The yield $r(x: t)$ is the return from $t$ to $t+x$ on a security with $x$ months to maturity at $t$. Since continuously compounded returns are additive, $r(x: t)$ is the sum of the return on the security from $t$ to $t+x-y$ and the yield to be observed at $t+x-y$,

$$r(x: t) = h(x, y: t+x-y) + r(y: t+x-y). \tag{9}$$

Substituting (9) and (5) into the forward-rate definition (1) gives

$$f(x, y: t) = h(x, y: t+x-y) + [r(y: t+x-y) - r(y: t)]. \tag{10}$$

Eq. (10) says that (8) holds for the realized return, $h(x, y: t+x-y)$, and the change in the field, $r(y: t+x-y) - r(y: t)$, as well as for the expected values. The reason both (8) and (10) can hold is that the uncertainty at $t$ about the holding period return and the future spot rate in (10) is offsetting uncertainty about the price of a $y$-month security to be observed at $t+x-y$.

Eqs. (8) and (10) are the seeds of complementary regressions to identify variation in expected term premiums, expected default premiums, and market forecasts of changes in yields.

### 3.2. *Term premium regressions*

Subtracting the yield, or spot rate, on a one-month security of the same kind from the forward rate of (8) gives the forward-rate term premium,

$$f(x, y: t) - r(1: t) = [E_t h(x, y: t+x-y) - r(1: t)] + [E_t r(y: t+x-y) - r(y: t)]. \tag{11}$$

Variation in the expected term premium and the expected yield change in (11) can then be measured with regressions of the realized term premium and the realized yield change on the forward-rate term premium,

$$h(x, y: t+x-y) - r(1:t) = a_1 + b_1[f(x, y:t) - r(1:t)] + u(t+x-y), \tag{12}$$

$$r(y: t+x-y) - r(y:t) = a_2 + b_2[f(x, y:t) - r(1:t)] + v(t+x-y). \tag{13}$$

Since (10) implies that the dependent variables in (12) and (13) sum to their common explanatory variable, the two regressions are complementary. The intercepts in (12) and (13) sum to 0.0; the slopes sum to 1.0 and have a common standard error, and the residuals sum to 0.0 period by period. Evidence that $b_1$ is not reliably different from 1.0 is consistent with the hypothesis that all variation in the forward-rate term premium reflects a time-varying expected term premium. Evidence that $b_1$ is reliably different from 0.0 and 1.0 means that $b_2$ is also reliably different from 0.0 and 1.0. Such evidence is consistent with the hypothesis that the forward-rate term premium contains both a time-varying expected term premium and power to forecast the change in the $y$-month yield $x-y$ months ahead.

Estimates of the term premium regression (12) are in table 2. All of the regression slopes are more than 2 standard errors above 0.0, and estimates more than 4 standard errors from 0.0 are common. The evidence is strong that forward-rate term premiums contain time-varying expected term premiums.

The slope in the B3/S1 regression for bills is more than 2 standard errors below 1.0. This regression is consistent with the evidence of Fama (1984b) that short-maturity forward-rate term premiums for bills show power to forecast short-term changes in yields. However, although the B12/S6 regression for CD's comes close, the B3/S1 regression for bills produces the only slope more than 2 standard errors below 1.0. All but one of the regression slopes are 0.79 or greater, and half are greater than 0.9. The thrust of the evidence is that most of the variation in forward-rate term premiums reflects variation in current expected term premiums rather than forecasts of changes in yields.

### 3.3. *Yield premium regressions*

Another perspective on the information in forward rates is provided by the forward-rate yield premium, obtained by subtracting the yield on a $y$-month security of the same type from the B$x$/S$y$ forward rate of (8),

$$f(x, y:t) - r(y:t) = [\mathrm{E}_t h(x, y: t+x-y) - r(y:t)] + [\mathrm{E}_t r(y: t+x-y) - r(y:t)]. \tag{14}$$

Table 2

Term and yield premium regressions for bills, bankers' acceptances (BA's), commercial paper, and certificates of deposit (CD's).[a]

| | $b$ | $s(b)$ | $a$ | $s(a)$ | $R^2$ | Residual autocorrelations $\rho_1$ | $\rho_2$ | $\rho_3$ | $\rho_4$ | $\rho_5$ | $\rho_6$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Part A. Estimates of term premium regression (12)* | | | | | | | | | | | |
| $h(x, y : t+x-y) - r(1:t) = a + b[f(x, y:t) - r(1:t)] + u(t+x-y)$ | | | | | | | | | | | |
| B3/S1 (January 1967 to October 1984, $N = 214$) | | | | | | | | | | | |
| Bills | 0.79 | 0.10 | 0.09 | 0.07 | 0.46 | 0.48 | −0.03 | −0.12 | −0.14 | −0.12 | −0.12 |
| BA's | 0.92 | 0.26 | −0.00 | 0.08 | 0.16 | 0.55 | 0.08 | −0.13 | −0.17 | −0.13 | −0.19 |
| Paper | 0.96 | 0.19 | −0.01 | 0.07 | 0.24 | 0.53 | 0.05 | −0.07 | −0.20 | −0.13 | −0.16 |
| CD's | 0.87 | 0.22 | 0.07 | 0.08 | 0.19 | 0.55 | 0.02 | −0.13 | −0.19 | −0.14 | −0.18 |
| B6/S3 (January 1967 to October 1984, $N = 214$) | | | | | | | | | | | |
| Bills | 1.10 | 0.21 | −0.15 | 0.17 | 0.24 | 0.68 | 0.23 | −0.13 | −0.21 | −0.24 | −0.25 |
| BA's | 0.98 | 0.22 | −0.05 | 0.22 | 0.13 | 0.70 | 0.23 | −0.13 | −0.22 | −0.23 | −0.21 |
| Paper | 0.79 | 0.20 | −0.02 | 0.21 | 0.13 | 0.71 | 0.25 | −0.10 | −0.20 | −0.21 | −0.23 |
| CD's | 0.80 | 0.17 | 0.01 | 0.22 | 0.14 | 0.71 | 0.24 | −0.12 | −0.21 | −0.23 | −0.22 |
| B12/S6 (November 1971 to July 1984, $N = 153$) | | | | | | | | | | | |
| Bills | 1.04 | 0.23 | −0.26 | 0.30 | 0.23 | 0.80 | 0.49 | 0.24 | 0.03 | −0.14 | −0.25 |
| CD's | 0.64 | 0.22 | −0.22 | 0.40 | 0.15 | 0.82 | 0.54 | 0.30 | 0.08 | −0.10 | −0.22 |
| *Part B. Estimates of yield premium regression (15)* | | | | | | | | | | | |
| $h(x, y : t+x-y) - r(y:t) = a + b[f(x, y:t) - r(y:t)] + u(t+x-y)$ | | | | | | | | | | | |
| B6/S3 (January 1967 to October 1984, $N = 214$) | | | | | | | | | | | |
| Bills | 1.13 | 0.19 | −0.13 | 0.16 | 0.14 | 0.68 | 0.23 | −0.13 | −0.20 | −0.24 | −0.26 |
| BA's | 0.92 | 0.26 | −0.03 | 0.22 | 0.08 | 0.70 | 0.23 | −0.13 | −0.22 | −0.23 | −0.21 |
| Paper | 0.59 | 0.24 | −0.02 | 0.21 | 0.05 | 0.70 | 0.25 | −0.09 | −0.18 | −0.19 | −0.21 |
| CD's | 0.64 | 0.22 | 0.01 | 0.22 | 0.06 | 0.71 | 0.26 | −0.10 | −0.19 | −0.21 | −0.21 |
| B12/S6 (November 1971 to July 1984, $N = 153$) | | | | | | | | | | | |
| Bills | 0.75 | 0.27 | −0.18 | 0.33 | 0.08 | 0.80 | 0.51 | 0.26 | 0.05 | −0.12 | −0.23 |
| CD's | 0.33 | 0.28 | −0.34 | 0.39 | 0.02 | 0.82 | 0.57 | 0.34 | 0.13 | −0.03 | −0.13 |

[a] $h(x, y : t+x-y)$ is the Bx/Sy return on a security bought at $t$ and sold at $t+x-y$. $f(x, y:t)$ is the Bx/Sy forward rate observed at $t$, and $r(y:t)$ is the yield on a security with $y$ months to maturity at $t$. $s(b)$ and $s(a)$ are the standard errors of the regression coefficients, adjusted for the autocorrelation induced by monthly observations on multi-month returns. See Hansen and Hodrick (1980). $R^2$ is the coefficient of determination, and $\rho_k$ is the residual autocorrelation for lag $k$. If the population autocorrelations are 0.0, the standard error of $\rho_k$ for the B3/S1 and B6/S3 regressions is about 0.07, and the standard error of $\rho_k$ for the B12/S6 regressions is about 0.08.

Regressions of the realized yield premium and yield change on the forward-rate yield premium can then be used to measure variation in the expected yield premium and the expected yield change in (14),

$$h(x, y:t+x-y) - r(y:t) = a_1 + b_1[f(x, y:t) - r(y:t)] + u(t+x-y), \tag{15}$$

$$r(y:t+x-y) - r(y:t) = a_2 + b_2[f(x, y:t) - r(y:t)] + v(t+x-y). \tag{16}$$

Since (10) implies that the dependent variables in (15) and (16) sum to their common explanatory variable, the two regressions are complementary in the same sense as (12) and (13). Evidence that $b_1$ is not reliably different from 1.0 is consistent with the hypothesis that all variation in the forward-rate yield premium is due to a time-varying expected yield premium. Evidence that $b_1$ is greater than 0.0 and less than 1.0 means that $b_2 = 1 - b_1$ is also between 0.0 and 1.0. Such evidence is consistent with the hypothesis that the forward-rate yield premium contains both a time-varying expected yield premium and power to forecast the change in the $y$-month yield.

The term premium regression (12) measures variation in B$x$/S$y$ expected returns net of the return on a one-month security of the same type. In contrast, the yield premium regression (15) measures variation in B$x$/S$y$ expected returns net of the yield on a $y$-month security. In a sense, the yield premium regressions measure marginal expected returns. For example, the regression for $x = 12$ and $y = 6$ measures variation in the premium of the six-month B12/S6 expected return, $E_t h(12, 6:t+6)$, over the current six-month yield, $r(6:t)$.

Likewise, for the B6/S3 and B12/S6 maturities the yield change regressions (13) and (16) are different, and (16) provides the more natural tests of the forecast power of three- and six-month forward rates. The regression of $r(3:t+3) - r(3:t)$ on $f(6,3:t) - r(3:t)$ provides a direct test of the hypothesis that the spread of the time $t$ three-month forward rate over the time $t$ three-month yield has power to forecast the change in the three-month yield over the following three months. Likewise, the regression of $r(6:t+6) - r(6:t)$ on $f(12,6:t) - r(6:t)$ provides a direct test of the hypothesis that the spread of the time $t$ six-month forward rate over the time $t$ six-month yield has power to forecast the change in the six-month yield over the following six months.

Estimates of the yield premium regression (15) are in table 2. The slope coefficients in the B6/S3 regressions for bills and BA's are 1.13 and 0.92. Thus, the B6/S3 regressions for bills and BA's suggest that the spread of the

B6/S3 forward rate over the three-month yield just tracks the spread of the B6/S3 expected return, $E_t h(6,3:t+3)$, over the three-month yield, $r(3:t)$. The B6/S3 regressions for commercial paper and CD's produce slope coefficients (0.59 and 0.64) further (but not quite 2 standard errors) from 1.0, suggesting that forward-rate yield premiums for commercial paper and CD's in part reflect forecasts of changes in three-month yields.

The strongest suggestion that CD forward-rate yield premiums forecast changes in yields comes from the B12/S6 regression, which produces a slope more than 2 standard errors below 1.0. The estimate of the slope, 0.33, suggests that two-thirds of the variation of the $f(12,6:t) - r(6:t)$ forward-rate yield premium for CD's is due to forecasts of changes in the six-month yield on CD's six months ahead. This is the only estimate that more than half the variation of a forward-rate variable reflects forecasts of future yields rather than current expected returns. In contrast, the B12/S6 yield premium regression for bills produces a slope, 0.75, which is less than 1.0 standard error from 1.0, and which suggests that most of the variation in the forward-rate yield premium reflects variation in the current expected yield premium.

### *3.4. Default premium regressions*

The basic regression technique can be used to measure variation in expected default premiums. Using (8), the difference between the time $t$ B$x$/S$y$ forward rates on a private-issuer security and a bill is

$$\begin{aligned} & f^{\mathrm{p}}(x,y:t) - f^{\mathrm{b}}(x,y:t) \\ &= \mathrm{E}_t\left[h^{\mathrm{p}}(x,y:t+x-y) - h^{\mathrm{b}}(x,y:t+x-y)\right] \\ &\quad + \left[\mathrm{E}_t r^{\mathrm{p}}(y:t+x-y) - r^{\mathrm{p}}(y:t)\right] \\ &\quad - \left[\mathrm{E}_t r^{\mathrm{b}}(y:t+x-y) - r^{\mathrm{b}}(y:t)\right], \end{aligned} \tag{17}$$

where the superscripts p and b identify variables for the private-issuer security and the bill. Consider the regression of the realized default premium on the forward-rate default premium of (17),

$$\begin{aligned} & h^{\mathrm{p}}(x,y:t+x-y) - h^{\mathrm{b}}(x,y:t+x-y) \\ &= a_1 + b_1\left[f^{\mathrm{p}}(x,y:t) - f^{\mathrm{b}}(x,y:t)\right] + u(t+x-y). \end{aligned} \tag{18}$$

Evidence that $b_1$ is not reliably different from 1.0 is consistent with the hypothesis that all variation in the time $t$ forward-rate default premium is due to the time $t$ expected default premium in (17). Evidence that $b_1$ is different

Table 3

Default premium regressions; estimates of (18) for banker's acceptances (BA's), commercial paper, and certificates of deposit (CD's).[a]

$$h^{p}(x, y: t+x-y) - h^{b}(x, y: t+x-y) = a + b[f^{p}(x, y: t) - f^{b}(x, y: t)] + u(t+x-y)$$

| | $b$ | $s(b)$ | $a$ | $s(a)$ | $R^2$ | Residual autocorrelations | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $p_1$ | $p_2$ | $p_3$ | $p_4$ | $p_5$ | $p_6$ |
| B3/S1 (January 1967 to October 1984, $N = 214$) | | | | | | | | | | | |
| BA's | 1.05 | 0.06 | −0.04 | 0.06 | 0.78 | 0.20 | −0.38 | −0.08 | −0.10 | −0.06 | 0.12 |
| Paper | 1.06 | 0.05 | −0.05 | 0.05 | 0.79 | 0.13 | −0.39 | 0.02 | −0.08 | −0.11 | 0.14 |
| CD's | 1.05 | 0.05 | −0.04 | 0.06 | 0.77 | 0.23 | −0.34 | −0.12 | −0.19 | −0.05 | 0.17 |
| B6/S3 (January 1967 to October 1984, $N = 214$) | | | | | | | | | | | |
| BA's | 1.30 | 0.10 | −0.13 | 0.07 | 0.49 | 0.49 | 0.19 | −0.23 | −0.26 | −0.23 | −0.19 |
| Paper | 1.10 | 0.08 | −0.03 | 0.09 | 0.50 | 0.52 | 0.17 | −0.21 | −0.31 | −0.22 | −0.28 |
| CD's | 1.33 | 0.11 | −0.14 | 0.11 | 0.41 | 0.56 | 0.15 | −0.27 | −0.34 | −0.28 | −0.21 |
| B12/S6 (November 1971 to July 1984, $N = 153$) | | | | | | | | | | | |
| CD's | 0.96 | 0.09 | 0.02 | 0.10 | 0.40 | 0.69 | 0.52 | 0.23 | −0.10 | −0.23 | −0.44 |

[a] $h(x, y: t+x-y)$ is the B$x$/S$y$ return on a security bought at $t$ and sold at $t+x-y$. $f(x, y: t)$ is the B$x$/S$y$ forward rate observed at $t$. The superscripts p and b identify returns and forward rates for private-issuer securities and bills. $s(b)$ and $s(a)$ are the standard errors of the regression coefficients, adjusted for the autocorrelation induced by monthly observations on multi-month returns. See Hansen and Hodrick (1980). $R^2$ is the coefficient of determination and $p_k$ is the residual autocorrelation for lag $k$. Under the hypothesis that the population autocorrelations are 0.0, the standard error of $p_k$ for the B3/S1 and B6/S3 regressions is about 0.07, and the standard error of $p_k$ for the B12/S6 regressions is about 0.08.

from 1.0 implies that variation in the forward-rate default premium in part reflects the differential market forecasts in (17) of the changes from $t$ to $t+x-y$ in the yields on the private-issuer security and the bill.

Estimates of (18) are in table 3. Five of seven regression slopes are within 0.1 of 1.0, and only one is more than 2 standard errors from 1.0. All the regression slopes are more than 10 standard errors from 0.0. The evidence that forward-rate default premiums contain time-varying expected default premiums is strong.

## 4. Term premiums, default premiums, and business cycles

Slopes close to 1.0 in the term premium and default premium regressions suggest that forward-rate term premiums and default premiums provide a direct picture of the behavior of the expected term and default premiums in returns. The plots discussed next bring the evidence to life by showing the relations between forward-rate term premiums, default premiums, and the business cycle.

The National Bureau of Economic Research (NBER) dates a business cycle peak in November 1973 and the subsequent trough in March 1975. They date two recessions in the early 1980's, with the first peak in January 1980 and the final trough in November 1982.

### *4.1. Treasury-bill forward-rate term premiums*

Fig. 1 plots forward-rate term premiums for bills for the B6/S3 and B12/S6 maturities. To reduce clutter, the B3/S1 forward-rate term premium is not shown. Since forward-rate term premiums are net of the one-month bill rate, the horizontal line at 0.0 is the reference point for one-month bills.

From 1973 to mid-1975 forward rates on bills never increase monotonically with maturity. The B12/S6 forward rate is generally less than the B6/S3 rate and often less than the rate on one-month bills. This period covers the first severe post-World War II recession and several months before the recession. For the pre-recession year 1972 and for the post-recession period from mid-1975 to the end of 1978, the term structure of forward rates is generally upward sloping. Toward mid-1979, again somewhat before the business cycle peak, humps reappear in the term structure of forward rates, and the variability of forward-rate term premiums increases. Humps are the rule during the subsequent recession at least to mid-1982. Thereafter, the term structure of forward rates is more often upward sloping.

Term premiums in the expected returns on longer-term bills are usually interpreted as rewards for risk. It is plausible that rewards change as a function of risks that vary with the business cycle. If forward rates are just expected returns, however, humps in the term structure of forward rates imply

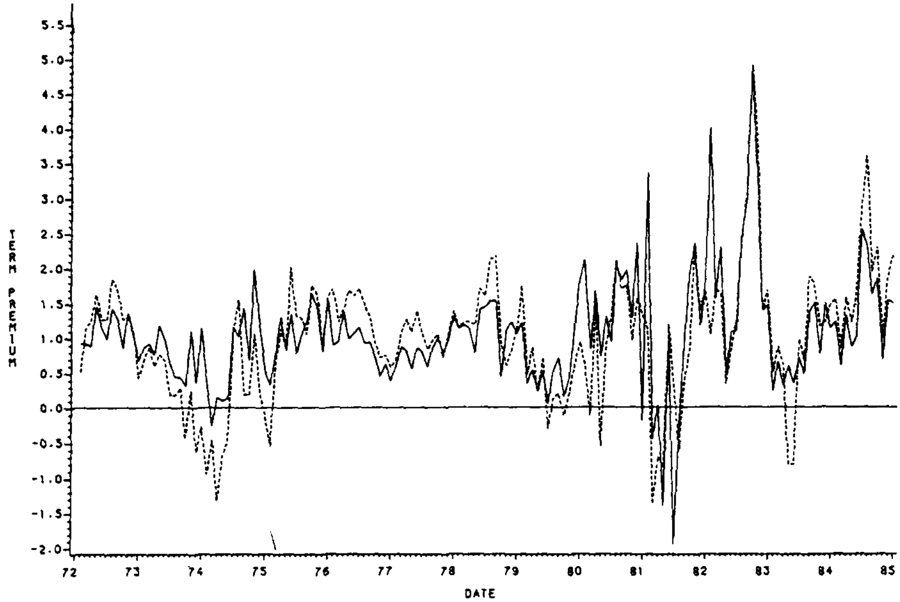


Fig. 1. $Bx/Sy$ Treasury bill forward-rate term premiums. A forward-rate term premium is the $Bx/Sy$ forward rate, $f(x, y : t)$, minus the one-month spot rate, $r(1 : t)$. The solid line plots the B6/S3 term premium. The dashes plot the B12/S6 term premium.

that the ordering of risks and rewards across maturities changes with the business cycle and is not always monotonic. The phenomenon poses an interesting challenge for equilibrium theories of the term structure.

### 4.2. *CD forward-rate default premiums*

Fig. 2 plots CD forward-rate default premiums. A forward-rate default premium is the difference between the contemporaneous CD and bill forward rates for a given $Bx/Sy$ maturity combination. To reduce clutter, the B3/S1 premium is not shown.

Shorter-maturity forward-rate default premiums are higher during the two recessions (1973–75 and 1979–82) and lower during other periods. The phenomenon is striking for the B1/S0 premiums and for the B3/S1 premiums (not shown) which sometimes exceed 3.0 percent during the recessions, but weaker for the B6/S3 premiums. It makes sense that default premiums are higher in bad times, but it is less obvious that this pattern would be stronger for shorter maturities. In fact, the longest-maturity forward-rate default premium (B12/S6) seems to move opposite the others and is often negative

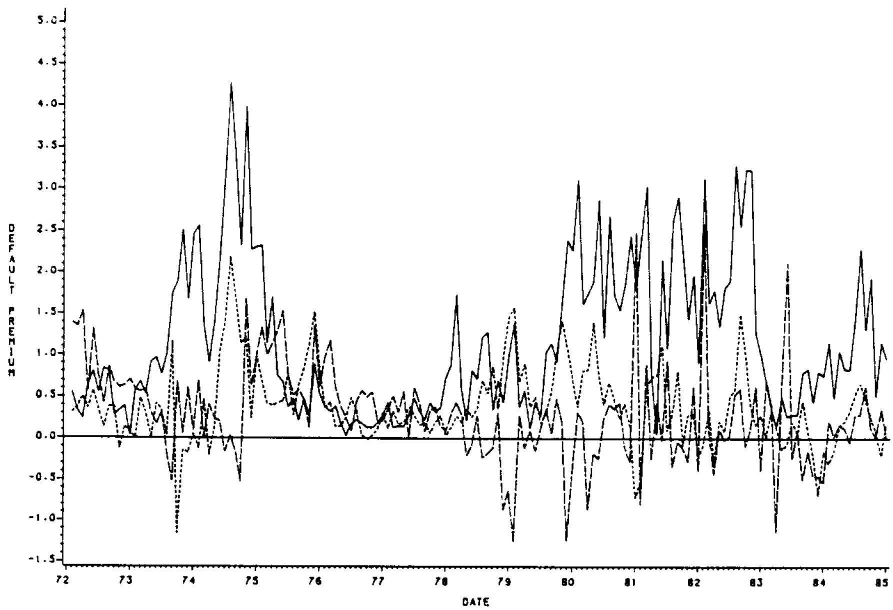


Fig. 2. $Bx/Sy$ forward-rate default premiums for certificates of deposit (CD's). A default premium is the $Bx/Sy$ CD forward rate minus the $Bx/Sy$ Treasury bill forward rate. The solid line plots the B1/S0 default premium; the short dashes plot the B6/S3 default premium; and the longer dashes plot the B12/S6 default premium.

during the two recessions, that is, the B12/S6 CD forward rate is often less than the B12/S6 forward rate for bills.

Like the behavior of longer- versus shorter-maturity default premiums in fig. 2, the term structure of average default premiums in table 1 is counterintuitive. In the results for the total sample, average default premiums in one-month CD interest rates (B1/S0) are 1.2 percent per year. Whether calculated from forward rates or realized returns, average default premiums are 0.78 percent for the B3/S1 maturity combination, and they drop to 0.4 and 0.3 percent per year for B6/S3 and B12/S6. This downward pattern of average default premiums (also observed for BA's and A1–P1 commercial paper) is the reverse of both intuition and Merton's (1974) prediction about default premiums from the option-pricing model of Black and Scholes (1973). In Merton's model, default premiums on high-grade securities like those studied here rise with maturity.

It is well to emphasize that the data are secondary market quotes from Salomon Brothers' traders on different maturities of securities they regard as perfect substitutes in terms of default risk. Choice of perfect substitutes is not difficult since important issuers of prime-quality securities typically have securities outstanding for different maturities.

I have monthly quotes on A2–P2 (lower grade) commercial paper for June 1974 to April 1984. The average premiums of A2–P2 returns over A1–P1 returns are similar across maturities (0.61 percent per year for B1/S0, 0.57 percent for B3/S1, and 0.57 percent for B6/S3). Thus, an inverted pattern of average default premiums across maturities seems special to comparisons of private-issuer securities and bills – a conclusion that awaits explanation.

### *4.3. CD forward-rate term premiums*

Humped term structures of bill forward rates during recessions combined with term structures of CD default premiums that tend to be inverted imply the clearcut variation of CD forward-rate term premiums shown in fig. 3. Unlike fig. 2, fig. 3 is easy to follow, and all available maturities are included.

While the term structure of bill forward rates is humped during the recession of 1973–75, the term structure of CD forward rates is often inverted,

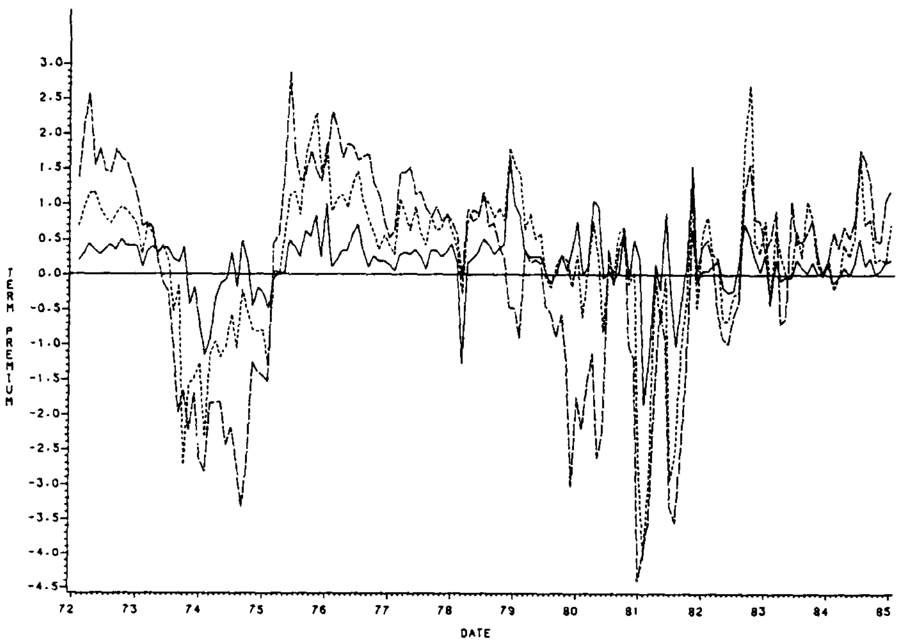


Fig. 3. $Bx/Sy$ forward-rate term premiums for certificates of deposit (CD's). A forward-rate term premium is the $Bx/Sy$ CD forward rate, $f(x, y : t)$, minus the one-month CD spot rate, $r(1 : t)$. The solid line plots the B3/S1 term premium; the short dashes plot the B6/S3 term premium; and the longer dashes plot the B12/S6 term premium.

that is, forward rates often decline monotonically with maturity. During this period, CD forward rates for the B6/S3 and B12/S6 maturities are rather consistently below interest rates on one-month CD's. A similar pattern is observed during the 1979–82 recession. During good times (1972, 1975–78, 1983–84), the term structure of CD forward rates, like the term structure of bill forward rates, is more often upward sloping.

Whether measured from forward rates or returns, average term premiums for CD's for the total sample period in table 1 are close to 0.0. Fig. 3 indicates that the averages mask downward-sloping term structures of forward rates around recessions that balance against upward-sloping term structures during good times. Again, if forward rates are just expected returns that reflect compensation for risk, fig. 3 says that the ordering of these rewards and risks changes with the business cycle. The phenomenon poses an interesting challenge for equilibrium theories of the term structure.

The behavior of the private-issuer term structure in figs. 2 and 3 is not special to CD's. Plots for BA's and commercial paper yield the same story about the cyclical behavior of forward rates.

## 5. Trading rule tests

The regression evidence is consistent with a world in which the B$x$/S$y$ forward rate, calculated from the current prices of $x$- and $y$-month securities, is the expected return if the $x$-month security is bought now and sold later when it has $y$ months to maturity. Since the term structure of forward rates is not always upward sloping, the regressions suggest that a variable-maturity trading rule based on forward rates can produce higher expected returns than strategies that always buy and sell at fixed maturities.

### *5.1. Description of the trading rule*

The following trading rule is tested:

At the beginning of each month find the combination of buy maturity $x$ and anticipated sell maturity $y$ that maximizes the forward rate. Purchase one unit of the security at the buy maturity $x$. Sell securities purchased earlier that have maturities equal to or less than the current sell maturity $y$. Do not invest the proceeds from sales.

Following this variable-maturity trading rule each month generates a time series of portfolio holdings that are used to calculate monthly portfolio returns. These returns are compared to monthly returns on fixed-maturity portfolios that hold all maturities (equally weighted) between a fixed-buy-maturity $x$ and a fixed-sell-maturity $y$.

Since quotes are only available for one-, three-, six,- and twelve-month maturities, quotes for other maturities must be interpolated to obtain monthly portfolio returns. Any measurement error from interpolation has little effect on inferences since (a) the tests focus on total-sample average returns, and (b) buy and sell maturities are limited to maturities with actual quotes.

### 5.2. *Performance of the trading rule*

Table 4 shows average returns for fixed- and variable-maturity portfolios of bills and CD's with maturities to twelve months. For both bills and CD's the variable-maturity trading rule has a higher average return than any fixed-maturity portfolio. The advantage of the trading rule for bills over the best fixed-maturity portfolio (B6/S3) is 0.53 percent per year. The advantage of the trading rule for CD's over the best fixed-maturity portfolio (B6/S3) is 0.57 percent per year. These average differences between variable- and best fixed-maturity portfolio returns are 1.58 and 1.93 standard errors from 0.0.

Alternatively, the liquidity preference hypothesis says that expected returns increase with maturity and B12/S6 is the optimal strategy for our data. B12/S6 is thus a reasonable candidate for the best fixed-maturity portfolio that does not use the hindsight of the sample returns. The variable-maturity trading rules for bills and CD's beat the B12/S6 fixed-maturity portfolios by 0.78 and 0.90 percent per year. These average return differences are 1.81 and 1.98 standard errors from 0.0.

Table 4 indicates that, unlike bills, there are no reliable term premiums in the expected returns on fixed-maturity CD portfolios. For bills, the average term premiums for the B3/S1 and B6/S3 maturities are 0.57 and 0.96 percent per year, and they are 5.06 and 3.41 standard errors from 0.0. In contrast, the largest average term premium for the fixed-maturity CD portfolios is 0.17 percent per year, which is only 0.51 standard errors from 0.0. However, the CD variable-maturity trading rule produces an average term premium, 0.73 percent per year, which is 2.02 standard errors from 0.0. Thus, periodic expected term premiums in private-issuer returns are identified with the information about time-varying expected returns used in the variable-maturity trading rule.

It is well to contrast the trading rule with the regressions. The regressions test whether variation in forward rates captures variation in expected returns. As long as expected returns vary, the regressions can rightly signal strong information in forward rates even if the term structure of forward rates is always upward sloping. In contrast, the variable-maturity trading rule can beat the best fixed-maturity portfolio only when there are periodic humps or inversions in the term structure of forward rates (and expected returns) that cause the maturity combination that maximizes the forward rate to change through time. The evidence in table 4 is that humps and inversions are

Table 4

Summary statistics for annualized percent fixed- (Bx/Sy) and variable-maturity portfolio returns for Treasury bills and certificates of deposit (CD's) with maturities to twelve months; November 1971 to December 1984; $N = 158$.

| | Mean | Std. dev. | $t$(mean) | Autocorrelations: $s(\rho) = 0.08$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | $\rho_1$ | $\rho_2$ | $\rho_3$ | $\rho_4$ | $\rho_5$ | $\rho_6$ |
| *Bill portfolio returns* (Bx/Sy means buy at maturity x and sell at maturity y) | | | | | | | | | |
| B1/S0 | 7.89 | 2.97 | | 0.93 | 0.87 | 0.81 | 0.76 | 0.72 | 0.69 |
| B3/S1 | 8.46 | 3.65 | | 0.78 | 0.70 | 0.66 | 0.62 | 0.61 | 0.56 |
| B6/S3 | 8.85 | 4.93 | | 0.49 | 0.31 | 0.29 | 0.28 | 0.29 | 0.19 |
| B12/S6 | 8.60 | 8.00 | | 0.29 | 0.08 | −0.03 | 0.06 | 0.12 | 0.00 |
| Variable | 9.38 | 6.70 | | 0.51 | 0.43 | 0.16 | 0.19 | 0.18 | 0.18 |
| Variable − B6/S3 | 0.53 | 4.20 | 1.58 | 0.06 | 0.13 | −0.11 | 0.05 | 0.03 | 0.07 |
| Variable − B12/S6 | 0.78 | 5.43 | 1.81 | −0.17 | 0.02 | −0.12 | 0.18 | 0.13 | 0.06 |
| *CD portfolio returns* (Bx/Sy means buy at maturity x and sell at maturity y) | | | | | | | | | |
| B1/S0 | 9.08 | 3.57 | | 0.95 | 0.89 | 0.83 | 0.77 | 0.73 | 0.70 |
| B3/S1 | 9.22 | 4.02 | | 0.77 | 0.65 | 0.62 | 0.54 | 0.55 | 0.49 |
| B6/S3 | 9.25 | 5.49 | | 0.46 | 0.26 | 0.23 | 0.17 | 0.26 | 0.15 |
| B12/S6 | 8.92 | 8.56 | | 0.27 | 0.02 | 0.04 | −0.04 | 0.11 | 0.00 |
| Variable | 9.82 | 5.96 | | 0.40 | 0.40 | 0.36 | 0.28 | 0.22 | 0.18 |
| Variable − B6/S3 | 0.57 | 3.69 | 1.93 | 0.00 | −0.10 | 0.05 | 0.09 | −0.09 | −0.13 |
| Variable − B12/S6 | 0.90 | 5.73 | 1.98 | 0.13 | −0.16 | −0.04 | −0.06 | 0.02 | −0.09 |
| *Bill portfolio term premiums* (Bx/Sy bill return minus B1/S0 bill return) | | | | | | | | | |
| B3/S1 | 0.57 | 1.41 | 5.06 | 0.31 | 0.05 | −0.00 | −0.03 | 0.06 | −0.07 |
| B6/S3 | 0.96 | 3.55 | 3.41 | 0.21 | −0.01 | −0.08 | −0.02 | −0.03 | −0.16 |
| B12/S6 | 0.71 | 7.18 | 1.24 | 0.19 | −0.01 | −0.17 | −0.03 | 0.01 | −0.10 |
| Variable | 1.49 | 5.55 | 3.37 | 0.35 | 0.25 | −0.13 | −0.08 | −0.08 | −0.8 |
| *CD portfolio term premiums* (Bx/Sy CD return minus B1/S0 CD return) | | | | | | | | | |
| B3/S1 | 0.14 | 1.56 | 1.11 | 0.24 | −0.06 | −0.04 | −0.15 | 0.00 | −0.12 |
| B6/S3 | 0.17 | 4.11 | 0.51 | 0.25 | −0.02 | −0.04 | −0.10 | 0.04 | −0.11 |
| B12/S6 | −0.17 | 7.79 | −0.27 | 0.22 | −0.04 | −0.03 | −0.10 | 0.06 | −0.06 |
| Variable | 0.73 | 4.57 | 2.02 | 0.11 | 0.13 | 0.09 | 0.02 | −0.07 | −0.08 |
| *CD portfolio default premiums* (Bx/Sy return for CD's minus Bx/Sy return for bills) | | | | | | | | | |
| B1/S0 | 1.20 | 1.04 | 14.44 | 0.66 | 0.56 | 0.45 | 0.41 | 0.35 | 0.44 |
| B3/S1 | 0.76 | 1.35 | 7.10 | 0.07 | 0.16 | 0.22 | −0.03 | −0.01 | 0.17 |
| B6/S3 | 0.40 | 2.04 | 2.46 | −0.18 | −0.01 | 0.17 | −0.30 | 0.03 | 0.04 |
| B12/S6 | 0.31 | 3.33 | 1.19 | −0.42 | 0.06 | 0.23 | −0.27 | 0.03 | 0.03 |

frequent enough to allow the variable-maturity strategy to beat fixed-maturity portfolios for bills and CD's by statistically respectable if not overwhelming margins.

## 6. Conclusions

### *6.1. The information in the term structure*

The slope coefficients in the term premium, yield premium, and default premium regressions are generally close to 1.0, and they are rarely more than 2 standard errors from 1.0. The regressions support the conclusion that most of the variation in time $t$ forward-rate premiums is variation in time $t$ expected return premiums rather than in forecasts of future changes in yields. To a good approximation, a forward rate calculated from current prices of $x$ (the longer maturity) and $y$ (the shorter maturity) month securities is the expected return if the $x$-month security is bought now and sold later when it has $y$ months to maturity. Equivalently, the current (log) price of a $y$-month security is the expected value of future prices of $y$-month securities, so forward rates are current expected returns.

The CD yield premium regressions produce the only suggestion that longer-maturity forward rates have power to forecast changes in yields. However, the inferences from these regressions are not robust. The CD yield premium regressions are not confirmed by the yield premium regressions for bills. Moreover, the comparisons of the means of CD forward rates and returns for humped and monotone term structures in table 1 and the trading rule tests of table 4, which examine the information in forward rates from different perspectives, are consistent with the conclusion that variation in time $t$ CD forward rates is primarily variation in time $t$ expected returns.

### *6.2. Default premiums*

The regressions of realized default premiums on forward-rate default premiums document time-varying expected default premiums for all maturities of all private-issuer securities. Plots of forward-rate default premiums suggest that expected default premiums follow the business cycle. For all but the B12/S6 maturity combination, expected default premiums are higher during recessions and months immediately preceding business cycle peaks.

Default premiums that are larger during bad times make sense. More difficult to explain is the evidence that (a) average default premiums are highest for one-month securities and they decline with maturity, and (b) longer-maturity expected default premiums seem to move opposite to shorter-maturity premiums; that is, longer-maturity expected default premiums are lower (often negative) during recessions than during good times. These counterintuitive results evoke the ritual cry for future work.

### 6.3. Term premiums

Regressions of realized term premiums on forward-rate term premiums document time-varying expected term premiums in the returns on Treasury bills of all maturities. Plots of forward-rate term premiums suggest that expected term premiums on bills vary with the business cycle. The term structure of expected returns is humped during recessions and months preceding business cycle peaks, and it is generally upward sloping during good times.

The term premium regressions for private-issuer securities also document time-varying expected term premiums for all securities and maturities. Figs. 1 to 3 then show that the combination of (a) Treasury-bill term structures that are humped during recessions, and (b) larger forward-rate default premiums for shorter-maturity private-issuer securities during recessions, translates into private-issuer forward-rate term structures that are more frequently inverted during recessions. The recession inversions average out positively-sloped term structures during good times. Whether measured from returns or forward rates, average term premiums for private-issuer securities are close to 0.0 for the overall sample period. This is in contrast to the positive average term premiums observed for bills.

Term premiums are generally interpreted as rewards for risks. It is plausible that rewards and risks vary with business conditions. If forward rates are just expected returns, however, the humps and inversions in term structures of forward rates during recessions imply that the ordering of risks and rewards across maturities changes with business conditions and is not always monotonic. This behavior is inconsistent with simple term structure models like the liquidity preference hypothesis of Hicks (1946) and Kessel (1965). Perhaps it can be explained by modern intertemporal models like those of Merton (1973), Long (1974), Breeden (1979), or Cox, Ingersoll and Ross (1985). Again, the phenomenon evokes the ritual cry for future work.

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