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The October 1979 Change in the U.S. Monetary Regime: Its Impact on the Forecastability of Canadian Interest Rates

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ABSTRACT

Subsequent to the October 1979 shift in monetary policy in the United States, interest rates in North America not only reached unprecedented levels but also exhibited unprecedented volatility. Using Canadian data, the authors show that anticipated quarterly changes in long-term rates associated with the rational-expectations model have remained small during this post-shift period. The authors examine three sets of recorded forecasts of long-term interest rates in Canada and note their failure to improve upon the no-change prediction. The "perverse" relationship between the slope of the yield curve and the subsequent movement in long-term rates exists in the Canadian data but is of only modest value in a forecasting context. The excess returns on long-term bonds implicit in the recorded forecasts of the level of interest rates vary sharply, yet there is little evidence that forecasters have identified a predictable component of time-varying term premia.

IN OCTOBER 1979, THE FEDERAL Reserve implemented a new policy of targeting monetary aggregates rather than interest rates. Subsequent to this apparent change in the conduct of monetary policy, interest rates in the United States not only reached unprecedented levels but also exhibited unprecedented volatility. Reflecting the close linkages between U.S. and Canadian capital markets, interest rates in Canada exhibited similar behavior.[1]

One element of the October 1979 change in the monetary regime that is as yet unexplored is its impact on the "forecastability" of interest rates. Two theoretical points are now well known. First, Sargent [17] and Pesando [13] have shown that, under the joint hypothesis of rational expectations and a time-invariant term premium, short-term movements in long-term interest rates will be inher-

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[1] The increased volatility of interest rates in the United States in the period subsequent to the October 1979 shift in policy has received considerable attention. See, for example, Roley [16] and Walsh [20]. A comparable increase in the volatility of interest rates is evident in the Canadian data. During the six years prior to the shift in policy (1973:4 through 1979:3), the ninety-day T-bill rate had a quarterly mean of 8.38 percent and a standard deviation of 1.49 percent. During the six years subsequent to the shift in policy (1979:4 through 1985:3), these figures rose to 12.52 percent and 3.31 percent. For long-term Government of Canada bonds, the mean interest rate rose from 9.12 percent to 12.97 percent, while the standard deviation rose from 0.61 percent to 1.76 percent.

ently "nonforecastable," at least as long as the yield curve is reasonably flat.[2] Under this rational-expectations model of the term structure,[3] agents without access to inside information will be unable to improve upon the prediction that long-term rates will not change over the forecast horizon. Second, as emphasized by Pesando [14], the assumption of rational expectations does not preclude agents from outperforming the no-change prediction in their forecasts of short-term movements in short-term interest rates, *unless* the short-term interest rate *happens* to follow a random walk.

The unprecedented levels and volatility of interest rates make timely an investigation of two *empirical* questions. First, have the anticipated quarterly changes in long-term interest rates remained sufficiently "small" that the no-change prediction continues to characterize accurately the rational-expectations model? Second, have forecasters been able to outperform the no-change prediction in this environment of volatile interest rates?

There is an "awkward fact" regarding the slope of the term structure and the subsequent movement in long-term interest rates that also merits attention in a forecasting context. When the term structure has a positive slope (that is, when the long-term rate exceeds the short-term rate), the prediction of the rational-expectations model is that the long-term rate will subsequently rise. The anticipated capital loss is necessary to equalize the holding-period return on short- and long-term bonds up to the time-invariant term premium. Yet, as Shiller [18] has emphasized, on the basis of interest rate data drawn from both the United States and the United Kingdom, the empirical relationship appears to be the opposite. Under the null hypothesis that agents form rational expectations, the implication is that time-varying term premia *do* exist and are positively related to the slope of the yield curve. The quantitative importance of this relationship, the question of whether it resurrects the "forecastability" of short-term movements in long-term interest rates, and the question of whether it is reflected in recorded forecasts all merit attention.

The paper is organized as follows. First, we examine post-shift data on interest

[2] For simplicity, let $R_t^{(n)}$ be the interest rate on an n-period, pure discount bond. Let r_t be the interest rate on a one-period bond; then

$$\mathrm{E}_t(R_{t+1}^{(n)}) - R_t^{(n)} = \frac{1}{n}\,(\mathrm{E}_t(r_{t+n}) - r_t). \tag{F1}$$

The term on the right-hand side of (F1) reflects the "nonoverlapping" one-period rates (i.e., the one-period rate contained in $R_{t+1}^{(n)}$ that is not contained in $R_t^{(n)}$, and conversely). This term will be small if n is large and if the difference in the nonoverlapping rates is small. The latter will hold if the term structure is reasonably flat. The former will hold if the maturity of the long-term bond is large relative to the unit of observation, which equals the forecast horizon. For a bond with a given term to maturity, the shorter the forecast horizon, the larger is n. If the forecast horizon is ninety (thirty) days, then $n = 40$ (120) for a ten-year bond. This explains why it is only short-term movements in long-term interest rates that are not "forecastable" under the rational-expectations model.

[3] We use the term "rational-expectations model" to describe the expectations model of the term structure, inclusive of a time-invariant term premium, when it is coupled with the hypothesis that agents form rational expectations. This does not, of course, imply that term premia related to risk (such as those implied by the CAPM) are inconsistent with the hypothesis that agents form rational expectations.

rates in Canada to determine whether the anticipated quarterly changes in long-term interest rates under the rational-expectations model continue to be "small." Second, we evaluate three sets of recorded forecasts of short-term and long-term interest rates in Canada using the accuracy of the no-change prediction as a benchmark. We calculate the excess returns on long-term bonds that are implicit in the recorded forecasts and discuss the possibility that these can be interpreted as term premia. Third, we explore the relationship between the *future* change in the long-term interest rate and the *current* slope of the yield curve both before and after the October 1979 shift in policy. We quantify the importance of the time-varying term premia so identified and assess the extent to which their existence resurrects the "forecastability" of movements in long-term interest rates. A summary and statement of conclusions complete the paper.

I. Anticipated Changes in Long-Term Interest Rates under the Rational-Expectations Model

Let $E_t(H_t^{(n)})$ denote the expected return on an n-period bond held during period t, let r_t denote the one-period interest rate at the beginning of period t, and let $\phi^{(n)}$ denote the marginal term premium—assumed to be time invariant—accorded an n-period bond if held for one period. Then, in its most useful formulation for the present purpose,[4] the rational-expectations model requires

$$E_t(H_t^{(n)}) = r_t + \phi^{(n)}. \tag{1}$$

Let c denote the periodic coupon paid by the n-period bond, and let $P_t^{(n)}$ denote its price. Since an n-period bond, one period later, is an $(n-1)$-period bond, then

$$E_t(H_t^{(n)}) = \frac{c}{P_t^{(n)}} + \frac{E_t(P_{t+1}^{(n-1)}) - P_t^{(n)}}{P_t^{(n)}}. \tag{2}$$

If the bond is trading at par, then $c/P_t^{(n)} = R_t^{(n)}$. For a bond trading at par, (2) and (1) imply

$$R_t^{(n)} + \frac{E_t(P_{t+1}^{(n-1)}) - P_t^{(n)}}{P_t^{(n)}} = r_t + \phi^{(n)}. \tag{3}$$

Implicit in (3) is the value of the $(n-1)$-period interest rate expected to prevail at $t+1$. This is the long-term rate that produces the capital gain or loss necessary to satisfy (3). The anticipated change in the long-term interest rate is the difference between this expected long-term rate and its current value.

Because of Jensen's Inequality, expectations of bond prices and interest rates—which are inversely related—cannot *both* be unbiased. As formulated in (3), the unbiasedness of $E_t(P_{t+1}^{(n-1)})$ implies that $E_t(R_{t+1}^{(n-1)})$ is not an unbiased estimate of the corresponding spot rate.

[4] As is well known (Cox, Ingersoll, and Ross [3]), the several different formulations of the pure expectations model of the term structure are—due to Jensen's Inequality—inconsistent if interest rates are random.

Although Lintner [7] provides evidence that this bias is small, it is useful to circumvent the problem by employing the linearized expression for the holding-period yield on a long-term bond ($\tilde{H}_t^{(n)}$) derived by Shiller [18].[5] This expression, which is valid for a bond trading at or near par, is

$$\tilde{H}_t^{(n)} = \frac{R_t^{(n)} - \gamma_n R_{t+1}^{(n-1)}}{1 - \gamma_n}, \tag{4}$$

where $\gamma_n = \gamma(1 - \gamma^{n-1})/(1 - \gamma^n)$ and $\gamma = 1/(1 + \bar{R})$ and where $\bar{R}$ equals the "normal" long-term interest rate around which the expression for the holding-period yield is linearized. Equations (1) and (4) can be rearranged to yield

$$E_t(R_{t+1}^{(n-1)}) = (1/\gamma_n)[R_t^{(n)} - (1 - \gamma_n)(r_t + \phi^{(n)})]. \tag{5}$$

The anticipated *change* in the long-term interest rate under the rational-expectations model is thus

$$E_t(R_{t+1}^{(n-1)}) - R_t^{(n)} = [(1 - \gamma_n)/\gamma_n](R_t^{(n)} - (r_t + \phi^{(n)})). \tag{6}$$

If one has data on an index of long-term interest rates (ideally, a constant maturity index), one can ignore the change in the maturity of the bond and simply refer to the left-hand side of (6) as the anticipated change in the long-term rate.

Have the anticipated changes in the long-term interest rate under the rational-expectations model remained "small" subsequent to the October 1979 change in the policy regime? Since economists traditionally forecast macroeconomic variables on a quarterly basis and since recorded data on quarterly interest rate forecasts are available, this is the unit of observation adopted in the remainder of this paper. Data on ninety-day Treasury bills and long-term Government of Canada bonds, as well as data on ninety-day finance company paper and long-term corporate bonds, permit us to calculate the anticipated changes in the respective long-term rates. To implement equation (6), we need (a) to specify the terms to maturity of the respective indexes of long-term interest rates, (b) to estimate the marginal term premium, and (c) to choose the "normal" long-term rate around which to linearize the expression for the holding-period yield.

For both the Canada and the corporate bonds, the term to maturity is about seventeen years or sixty-eight quarters (n = 68).[6] As shown by McCulloch [8], the marginal term premium approaches the average term premium quite rapidly. The latter—under the rational-expectations model—is simply equal to the aver-

[5] Shiller [18] shows that the approximation error resulting from this linearization is not large, a point emphasized more recently by Campbell [1].

[6] The corporate bond series is the McLeod, Young, Weir ten industrials, compiled by McLeod, Young, Weir and Company Limited. The other series are compiled by the Bank of Canada. The corporate bond rates are those prevailing on the last business day in the quarter. All of the other rates are those prevailing on the last Wednesday in the quarter. For corporate bonds, the reported term-to-maturity figure of seventeen years is clouded by the existence of call options and sinking funds. The maturity figures are reported under the convention that the maturity of a bond equals its maturity date if the bond is trading beneath par and equals its earliest call date if the bond is trading above par. For this reason, one has more confidence in the constructed series of the anticipated changes in the long-term Canada rate.

age spread between the long-term and the corresponding short-term interest rates. During the period 1957:1 through 1985:3, the spread between the long-term Canada rate and the ninety-day bill rate averaged 113 basis points, and the spread between the corporate bond rate and the paper rate averaged 128 basis points. These figures are used to approximate the marginal term premium that appears in equation (6).[7] The average value of the long-term rates rose sharply in the post-shift sample period, from 6.72 percent to 12.97 percent for the Canada bonds and from 7.63 percent to 13.96 percent for the corporate bonds. In light of these sharp increases, we chose to linearize around the average values in each of the two subperiods.[8] Intuitively, it is the percent change in the long-term rate that is the key to producing the capital gain or loss required by equation (3). Thus, one would expect the higher level of interest rates in the post-shift period, other things equal, to be associated with larger (in absolute value) anticipated changes in the long-term rate under the rational-expectations model.

The actual and anticipated changes for the long-term Canada and corporate rates are summarized in Table I. To focus on the impact of the shift in the policy regime, the results for the period 1957:1 through 1979:3 are contrasted with those for the period 1979:4 through 1985:3.

The results indicate that anticipated changes in long-term rates are about three times larger after the shift in the policy regime, yet still relatively small. The mean absolute anticipated change in the long-term Canada rate equalled

Table I

Actual and Anticipated Changes in Long-Term Interest Rates in Canada: 1957:1 through 1985:3[a]

	Canada Bonds		Corporate Bonds	
	Anticipated	Actual	Anticipated	Actual
Period 1957:1 through 1979:3				
Mean Absolute Change	2.14	26.51	2.58	23.33
Maximum Absolute Change	7.04	127.00	9.46	119.00
Mean Change	0.49	7.04	0.18	6.45
Standard Deviation	2.72	34.84	3.27	30.82
Period 1979:4 through 1985:3				
Mean Absolute Change	6.19	108.67	7.02	113.13
Maximum Absolute Change	20.11	263.00	20.97	316.00
Mean Change	−3.02	2.42	−1.40	2.38
Standard Deviation	7.83	139.39	8.84	145.83

[a] All numbers refer to basis points at annual rates.

[7] Later in the paper, we recalculate the anticipated changes in the long-term rate under equation (6) using estimates of time-varying term premia and compare these results with the ones presented in Table I.

[8] We also performed the linearization around the actual value of the long-term rate in each period and then recalculated the anticipated changes in the long-term rate under the rational-expectations model. The results are very similar to those reported in Table I. For example, the mean absolute change in the long-term Canada rate in the post-shift period is 6.30 basis points if the linearization is redone in each period, compared with the 6.19 basis points reported in Table I. The maximum absolute change is 20.24 basis points, compared with the 20.11 basis points reported in Table I.

6.19 basis points after the shift, compared with 2.14 basis points before the shift.[9] For corporate bonds, the corresponding figures are 7.02 basis points and 2.58 basis points.[10] The maximum anticipated change in the Canada bond rate rose from 7.04 basis points to 20.11 basis points; in the corporate bond rate, it rose from 9.46 basis points to 20.97 basis points.

In spite of the increased size and volatility of the anticipated changes in the long-term rate during the post-shift period, these anticipated changes continue to be dominated by the actual changes. For the Canada bonds, the mean absolute value of the actual change in the long-term rate equalled 109 basis points, which is close to twenty times the mean absolute value of the anticipated change. Of particular note is the ratio of the variance of the anticipated changes to the variance of the actual changes. In the post-shift period, this ratio equalled 0.3 percent for the Canada bonds and 0.4 percent for the corporate bonds. These fractions are lower than the corresponding ones for the earlier sample period. Under the rational-expectations model, anticipated and unanticipated changes in the long-term rate must be uncorrelated. These figures thus imply that 99.7 percent (99.6 percent) of the variance of the observed changes in the Canada (corporate) bond rate in the post-shift period is due to "noise" associated with the receipt of new information.[11]

[9] We also calculated the anticipated change in one of the most actively traded long-term Canada bonds (the 9.5's of 2001), again as implied by the alternative of holding a ninety-day Treasury bill. For this calculation, we incorporated the fact that the maturity of the bond declines by one quarter with each observation. For this bond, the average absolute value of the anticipated change for the period 1979:4 to 1985:3 equalled 5.65 basis points.

Because of the dramatic rise in interest rates during the post-shift period, most seasoned bonds traded beneath par. In principle, this raises a number of tax complications, due to the fact that capital gains receive favorable tax treatment in Canada. To address this issue, we constructed our own index of long-term Canada bonds trading near par and then recalculated the actual and anticipated changes reported in Table I. The results are very similar. For example, the average absolute value of the anticipated change for the period 1979:4 to 1985:3 is 6.24 basis points, compared to 6.19 basis points in Table I.

If marginal investors are taxable, then the (gross-of-tax) expected return on long-term bonds will fall relative to Treasury bills when these bonds are trading at a discount. As noted by Kane [6], this effect is potentially important if one is interested in obtaining estimates of the mean values of term premia across maturities.

[10] If, contrary to most empirical studies, the term premium is set equal to zero (i.e., the pure-expectations hypothesis is assumed), the mean absolute anticipated changes in the long-term rate in the post-shift period rise to 6.93 and 8.37 basis points for Canada and corporate bonds, respectively. These higher values reflect the tendency of long-term rates to exceed short-term rates, which thus requires—on average—ex ante increases in long-term rates to produce the capital losses necessary to equilibrate ex ante returns.

[11] As noted by a referee, there exists the possibility of additional or alternative shift dates, perhaps linked to further changes in Fed policy. In October 1982, the Fed replaced the federal funds rate with nonborrowed reserves as its operating instrument. For the subsamples 1957:1 through 1979:3 and 1979:4 through 1985:3, and 1979:4 through 1982:3 and 1982:4 through 1985:3, we used the Goldfeld-Quandt [5] test to examine the stability of the regression of the actual change on the anticipated change in the long-term rate in the presence of heteroscedasticity. During the two major subperiods, all estimated coefficients are insignificant, and there is no evidence of a structural break. Interestingly, there is a significant structural break within the post-shift period. The relationship that prevails during the 1982:4 through 1985:3 subperiod is, however, unconvincing in economic terms and is perhaps best seen as a statistical anomaly. For Canada bonds, for example, the coefficient of the

II. An Analysis of Recorded Interest Rate Forecasts in Canada

Since December 1974, McLeod, Young, Weir and Company has conducted quarterly surveys of interest rate forecasts in Canada, receiving responses from thirty-five to forty individuals from the financial community. The respondents are pension fund managers, corporate treasurers, and the like, chosen on the basis of their likely involvement, either directly or indirectly, in the trading of financial securities. The criterion for inclusion is similar to that employed in the Kane-Malkiel and Goldsmith-Nagan surveys of interest rate forecasts in the United States. The latter have been analyzed by Kane [6] and Friedman [4], respectively. The Conference Board of Canada and Data Resources Incorporated (DRI) of Canada also publish, as part of their quarterly macroeconomic forecasts, prediction of the future levels of both short-term and long-term interest rates. To our knowledge, this is the exhaustive set of forecasts of Canadian interest rates that is available on a time-series basis.

We have updated these recorded forecasts, which were examined in an earlier study by Pesando [15]. We now assess the impact on their accuracy of the October 1979 shift in the U.S. monetary regime.

The root-mean-square errors of the recorded forecasts, both one quarter and two quarters ahead and for the pre- and post-shift sample periods, are shown in Table II.[12] Shown also are the root-mean-square errors of the no-change prediction. The no-change prediction or martingale forecasts are set equal to the interest rate at the end of the latest month that unambiguously precedes the month in which the recorded forecasts are made. This procedure confers, to the recorded forecasts, an informational advantage that typically consisted of about two weeks but in some cases approached a full month.

On balance, the recorded forecasts fare quite poorly. There is no evidence that the recorded forecasts of the long-term rates are superior to the no-change prediction. Forecasts of the long-term rate (or rates) by DRI and the Conference Board are significantly inferior to the martingale model in the post-shift period. The accuracy of the survey forecasts compiled by McLeod, Young, Weir is about the same as that of the no-change prediction. The most distinguishing feature of the post-shift results, however, is the deterioration in the accuracy of the recorded forecasts of the short-term rates. For both DRI and the Conference Board, these forecasts are *also* inferior to the no-change prediction.[13]

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anticipated change is 28.62 (with a t-statistic of 4.67), which suggests that actual changes are about thirty times the size of the anticipated changes.

[12] The forecasts of DRI and the Conference Board are for the average interest rate to prevail in the quarter, while the survey forecasts compiled by McLeod, Young, Weir are for end-of-quarter interest rates. To calculate the forecast errors for DRI and the Conference Board, realizations were set equal to the average interest rate in the quarter, as measured by the average of the interest rates on the last Wednesday in each month during the quarter. To calculate the forecast errors for the McLeod, Young, Weir surveys, realizations were set equal to the interest rate on the last Wednesday in the quarter.

[13] The root-mean-square errors reported for the pre-shift sample in Table II, for both the recorded forecasts and the martingale model, are larger—often considerably so—than the errors reported for a roughly similar period in Pesando [15]. The increased errors reflected the typically large errors that occurred in the first three quarters of 1979, which were not included in the earlier paper.

Table II

Recorded Forecasts of Short- and Long-Term Interest Rates versus the Martingale Alternative[a]

Source	Sample	Series	Root-Mean-Square Forecasting Errors: One-Period Recorded	One-Period Martingale	Two-Period Recorded	Two-Period Martingale
Data Resources of Canada	Pre-Shift					
	1975:2–1979:3	90-day Treasury bills	89.3	82.9	159.5	140.4
		90-day finance paper	74.9	80.9	142.6	141.5
		Long-term Canada bonds	42.6	37.3	87.0	81.0
		McLeod, Young, Weir 10 industrial bonds	45.7	36.7	90.4	77.2
		McLeod, Young, Weir 10 provincial bonds	38.6	37.0	81.7	79.2
	Post-Shift					
	1979:4–1985:2	90-day Treasury bills	189.3	179.0	323.5	304.5
		90-day finance paper	192.9	188.9	333.6	309.1
		Long-term Canada bonds	124.4	110.3	186.0	150.7
		McLeod, Young, Weir 10 industrial bonds	146.8	117.9	202.7	166.7
		McLeod, Young, Weir 10 provincial bonds	146.5	117.8	198.9	160.9
The Conference Board of Canada	Pre-Shift[b]					
	1975:1–1979:3	90-day finance paper	81.5	85.6	129.2	134.0
		McLeod, Young, Weir 10 industrial bonds	44.7	37.4	87.6	72.2
	Post-Shift[b]					
	1979:4–1984:4	90-day finance paper	167.5	142.3	293.2	277.2
		McLeod, Young, Weir 10 industrial bonds	147.9	112.1	184.2	170.5

McLeod, Young, Weir surveys	Pre-Shift					
	1974:4–1979:3	90-day finance paper	98.4	118.0	173.1	178.4
		McLeod, Young, Weir 10 industrial bonds	43.5	45.2	95.0	92.3
		McLeod, Young, Weir 10 provincial bonds	46.7	49.0	99.7	93.8
	Post-Shift[c]					
	1979:4–1985:2	90-day finance paper	265.2	282.1	344.8	343.6
	1979:4–1982:4	McLeod, Young, Weir 10 industrial bonds	193.3	191.1	242.3	240.0
	1979:4–1982:4	McLeod, Young, Weir 10 provincial bonds	187.4	194.5	231.6	236.1

[a] DRI and the Conference Board forecast the average value of the interest rate during the quarter. The realization, in calculating the forecast errors, is set equal to the average value of the interest rate during the quarter to which the recorded forecast pertains. In the McLeod, Young, Weir surveys, it is the end-of-quarter interest rate that is being forecast, and the realizations used are the rates prevailing on the last Wednesday of the quarter for which the forecast is made. Forecast dates for the recorded figures vary within the quarter and are thus not strictly comparable across forecast sources. Forecast errors, in basis points, are expressed at annual rates.

[b] Observations for 1979:2 and 1981:3 were unavailable.

[c] Starting in 1983:1, the survey no longer requested participants to forecast the long-term provincial and corporate bond rates.

Table III

Success of the Recorded Forecasts in Signing Interest Rate Changes

Source	Sample	Series	Fraction of Forecast Changes That Are Correctly Signed: One-Period Horizon[a]	Fraction of Forecast Changes That Are Correctly Signed: Two-Period Horizon[b]
Data Resources of Canada	Pre-Shift			
	1975:2–1979:3	90-day Treasury bills	14/18	12/18
		90-day finance paper	11/18	11/18
		Long-term Canada bonds	12/18	13/18
		McLeod, Young, Weir 10 industrial bonds	7/18	10/18
		McLeod, Young, Weir 10 provincial bonds	9/18	13/18
	Post-Shift			
	1979:4–1985:2	90-day Treasury bills	14/23	14/22
		90-day finance paper	14/23	14/22
		Long-term Canada bonds	12/23	11/22
		McLeod, Young, Weir 10 industrial bonds	10/23	13/22
		McLeod, Young, Weir 10 provincial bonds	10/23	11/22
The Conference Board of Canada	Pre-Shift[c]			
	1975:1–1979:3	90-day finance paper	11/18	11/18
		McLeod, Young, Weir 10 industrial bonds	11/18	11/18
	Post-Shift			
	1979:4–1984:4	90-day finance paper	14/20	11/20
		McLeod, Young, Weir 10 industrial bonds	12/20	11/20

McLeod, Young, Weir surveys	Pre-Shift			
	1974:4–1979:3	90-day finance paper	14/20	15/20
		McLeod, Young, Weir 10 industrial bonds	12/20	13/20
		McLeod, Young, Weir 10 provincial bonds	12/20	13/20
	Post-Shift[c]			
	1979:4–1985:2	90-day finance paper	10/23	11/22
	1979:4–1982:4	McLeod, Young, Weir 10 industrial bonds	4/13	7/13
	1979:4–1982:4	McLeod, Young, Weir 10 provincial bonds	4/13	8/13

[a] $E_t\,(R_{t+1}^{(j)}) - R_t^{(j)}$.
[b] $E_t\,(R_{t+2}^{(j)}) - R_t^{(j)}$.
[c] Observations for 1979:2 and 1981:3 were unavailable.

Financial practitioners often focus on the ability of forecasters to predict turning points or to sign correctly future changes in interest rates. For portfolio managers, whose relevant decision may be to increase or to reduce the fraction of their funds allocated to long-term bonds, the implicit-loss function may assign considerable weight to directional guidance.

The success of the recorded forecasts in signing changes in interest rates is summarized in Table III. The key measure is the fraction of the one-period ($\mathrm{E}_t(R_{t+1}^{(n)}) - R_t^{(n)}$) and two-period ($\mathrm{E}_t(R_{t+2}^{(n)}) - R_t^{(n)}$) forecasts of the change in the long-term rate that are correctly signed. For the combined sample period, the fraction of the one-period forecasts of long-term rates that are correctly signed ranges from 0.415 (DRI, corporate bond rate) to 0.605 (Conference Board, corporate bond rate). When we examine the aggregate (across forecasters) number of successes in signing changes for each of the three long-term rates, we can reject the null hypothesis that the probability of success equals one half *only* for the two-periods-ahead forecasts of the provincial bond rate.[14] When predicted changes are large, one might expect that forecasters are more confident in their assessment of the future direction of interest rates. However, we find no evidence of improved performance if we focus only on those forecasts for which predicted changes are large. Suppose, for example, that we examine only the recorded forecasts that contain predicted changes with absolue values that exceed the median. Then we cannot reject the null hypothesis that the probability of success equals one half for *any* of the long-term rates, for either the one-period or two-period horizon. In short, there is nothing in the assessment of their directional accuracy to reverse the prior conclusion that the performance of the recorded forecasts of long-term rates is poor.

The success of the recorded forecasts in providing directional guidance is greater for the short-term rates. If we examine the aggregate (across forecasters) predictions of the bill and finance company paper rates, we can reject the null hypothesis of random success in signing changes during the combined sample period, for both the one-period and the two-period horizons. In the post-shift period, however, we cannot reject this null hypothesis for either rate. Further, we find no evidence of improved success in signing future changes in short-term rates if we examine only those forecasts that contain predicted changes that exceed (in absolute values) the median.

In spite of their lack of success in the post-shift period, it is instructive to examine two other features of the recorded forecasts. The first is the size of the forecast changes in the long-term rates. If these are large relative to those associated with the rational-expectations model, then those making the forecasts implicitly assume that either (a) the market is not efficient in its use of infor-

[14] The statistical test used here is based on the null hypothesis that performance in forecasting directional movements in interest rates is equivalent to tossing a coin; there are two equally probable alternatives. (Ex post, directional forecasts either agree with the data or they do not.) The test statistic used compares observed and expected (under the null hypothesis) frequencies to measure the significance of departures from the maintained model. Given that there are only two alternatives, the implicit adding-up constraint means that this statistic will be distributed chi-square with one degree of freedom. For a more detailed discussion of this testing procedure, see Mosteller and Rourke [11]. The more conventional binomial test yielded the same general results as those cited in the text.

Table IV

Mean Absolute Values of Forecast Quarterly Changes in Long-Term Interest Rates

Source	Sample	Series	Mean Absolute Values of Forecast Changes: One Quarter Ahead	Mean Absolute Values of Forecast Changes: Two Quarters Ahead
Data Resources of Canada[a]	1975:2–1979:3	Long-term Canada bonds	22.2	19.4
	1979:4–1985:2		66.7	32.8
	1975:2–1979:3	McLeod, Young, Weir	18.4	14.9
	1979:4–1985:2	10 industrial bonds	75.0	30.5
	1975:2–1979:3	McLeod, Young, Weir	19.8	18.9
	1979:4–1985:2	10 provincial bonds	76.8	31.4
The Conference Board of Canada[b]	1975:1–1979:3	McLeod, Young, Weir	16.1	13.5
	1979:4–1984:4	10 industrial bonds	34.9	20.4
McLeod, Young, Weir surveys	1975:1–1979:3	McLeod, Young, Weir	16.0	12.5
	1979:4–1982:4	10 industrial bonds	60.9	11.6
	1975:1–1979:3	McLeod, Young, Weir	14.8	11.6
	1979:4–1982:4	10 provincial bonds	62.1	23.0

[a] For DRI and the Conference Board, the last quarter's value as reported by the forecaster is subtracted from the one-quarter-ahead forecast to obtain the one-quarter-ahead forecast change. For the McLeod, Young, Weir surveys, the base rate reported in the surveys is used. Forecast changes are in basis points at annual rates.

[b] Observations for 1979:2 and 1981:3 were unavailable.

mation or (b) time-varying term premia do exist and have a systematic and hence "forecastable" component. Second, it is useful to identify the excess returns (i.e., $E_t(H_t^{(n)}) - r_t$) that are implicit in the recorded forecasts. If the market is efficient in its use of information, then these excess returns reflect the systematic component of the term premia anticipated by those making the interest rate forecasts.

The mean absolute values of the forecast changes in the long-term rates are presented in Table IV for both the pre-shift and post-shift periods. For all three sets of recorded forecasts, these mean absolute changes are far greater than those implied by the rational-expectations model. During the post-shift period, for example, the mean absolue changes in the long-term Canada rate forecast by DRI, one and two quarters ahead, were 66.7 basis points and 32.8 basis points, respectively. These forecast changes far exceed the mean absolue change of 6.19 basis points implied by the rational-expectations model during this post-shift period.

In Table V, we present the predictions of holding-period yields and excess returns on long-term bonds that are implicit in the two-quarters-ahead forecasts. We focus on the two-quarters-ahead forecasts for two reasons. First, there is no uncertainty about the base rate used in their construction, so they are more precisely measured. Second, the predicted changes in long-term rates are smaller, in absolute value, in the two-quarters-ahead forecasts. These forecasts will thus provide a conservative estimate of the implied variation in holding-period yields and excess returns.

The variation in predicted holding-period yields and excess returns is large, especially in the post-shift period. Consider, again, the DRI forecast of the long-term Canada rate. In the pre-shift period, the implied forecast of the quarterly holding-period yield on long-term Canada bonds has a mean of 12.82 percent and a range of −0.94 percent to 27.53 percent. In the post-shift period, the implied forecast has a mean of 16.42 percent and a range of −9.08 percent to 29.57 percent. Of particular interest, in the context of equation (1), are the implicit forecasts of excess returns. During the pre-shift period, the predicted excess return on long-term Canada bonds has a mean of 4.08 percent and a range of −9.74 percent to 18.67 percent. In the post-shift period, this excess return has a mean of 4.10 percent and a range of −21.09 percent to 19.34 percent.

Clearly, the excess returns on long-term bonds implicit in the recorded forecasts vary across a wide range. If those making these forecasts view the market as efficient, this variation suggests that they anticipate large quarter-to-quarter movements in time-varying term premia. In essence, forecasters have replaced $\phi^{(n)}$ in equation (1) with $\phi_t^{(n)}$:

$$E_t(H_t^{(n)}) = r_t + \phi_t^{(n)}. \qquad (1')$$

The forecasters implicitly view the term premium $\phi_t^{(n)}$ not only as varying sharply across time, but also as having an important systematic component. There is, however, nothing in the accuracy of the recorded forecasts to suggest that the forecasters have, indeed, identified such a component![15]

[15] Interestingly, practitioners sometimes criticize forecasters for predicting changes in long-term rates that are *too small* relative to observed changes. Melton [10, p. 3], for example, observes critically:

Table V

Holding-Period Yields and Excess Returns Implicit in the Recorded Forecasts[a]

Source	Sample	Series	Holding-Period Yield on Long-Term Bonds		Excess Return on Long-Term Bonds	
			Mean	Range	Mean	Range
Data Resources of Canada	1975:2–1979:3	Long-term Canada bonds	12.82	−0.94 to 27.53	4.08	−9.74 to 18.67
	1979:4–1985:2		16.42	−9.08 to 29.58	4.10	−21.08 to 19.34
	1975:2–1979:3	McLeod, Young, Weir 10 industrial bonds	12.63	1.91 to 25.89	3.38	−7.61 to 13.96
	1979:4–1985:2		17.30	−6.65 to 30.91	4.68	−19.15 to 20.45
The Conference Board of Canada[b]	1975:1–1979:3	McLeod, Young, Weir 10 industrial bonds	10.30	0.71 to 31.90	1.50	−8.41 to 25.98
	1979:4–1984:4		16.18	6.31 to 26.32	3.02	−12.92 to 16.50
McLeod, Young, Weir surveys	1974:4–1979:3	McLeod, Young, Weir 10 industrial bonds	13.06	6.85 to 20.34	4.08	−1.51 to 8.05
	1979:4–1982:4		15.82	2.20 to 29.69	1.60	−12.80 to 13.50

[a] Data refer to holding-period yields and excess returns based on the two-quarter-ahead forecasts of interest rate changes, as shown in Table IV. Holding-period yields and excess returns are expressed as percentage points at annual rates.

[b] Observations for 1979:2 and 1981:3 were unavailable.

Finally, we would like to address the question of whether these recorded forecasts may be viewed as representative of those of the market. Under the null hypothesis that the forecasts of the market fully utilize available information, one feature of the recorded forecasts is disconcerting. This is the deterioration in the quality of the predictions of future movements in the short-term rate during the post-shift period. When we investigate this issue, we find that there is a sharp break in the time-series properties of short-term interest rates in Canada subsequent to the 1979 shift in policy. From 1957:1 to 1979:3, and as reported in Pesando [15], the ninety-day Treasury bill and finance company paper rates in Canada follow an AR(2) process. For the period 1979:4 to 1985:2, however, the AR(2) model is inferior to an AR(1) model. Further, one cannot reject the null hypothesis that the coefficient of the lagged short rate is equal to one. When the subsequent change in either short rate is regressed on its current and lagged level, no coefficients are significant in the post-shift period.

The fact that short-term rates appear to follow a martingale process in the post-shift period provides an important perspective on the deterioration of the quality of the recorded forecasts. In particular, one *cannot* infer that these forecasts are weak-form inefficient, that is, that they fail to exploit the information contained in the history of the short-term rate. Rather, short-term rates appear to have become inherently less "forecastable" in the post-shift period.

III. The Slope of the Yield Curve and Future Changes in the Long-Term Interest Rate

Implicit in the rational-expectations model is a *positive* relationship between the *current* slope of the yield curve and the *subsequent* movement in the long-term interest rate. When the term structure has a positive slope (that is, when the long-term rate exceeds the short-term rate), the prediction of the rational-expectations model is that the long-term rate will subsequently *rise*. The anticipated capital loss is necessary to equalize—up to the time-invariant term premium—the holding-period return on short- and long-term bonds.

However, as Shiller [18] has noted using interest rate data drawn from both the United States and the United Kingdom, the empirical relationship appears to be the opposite. Subsequent movements in long-term rates are *negatively* related to the current slope of the yield curve. None of the data sets examined by Shiller extend beyond 1977, so his evidence does not pertain to the post-shift

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> . . . in the five years that *Institution Investor* has surveyed economists concerning their expectations for interest rates, the average absolute forecast change . . . was 97 basis points, compared to 173 basis points in reality!

Melton subsequently analyzes (p. 10) the "persistent tendency for some economists to understate the magnitude of future changes of interest rates."

The criticism that forecasters understate the actual volatility of long-term interest rates is, of course, dramatically at odds with the message from the rational-expectations model. Such critics would appear implicitly to reject the hypothesis that capital markets are efficient since the variation in ex post returns on long-term bonds is far greater than that which one might reasonably assign to time-varying term premia.

period.[16] Under the null hypothesis that agents form rational expectations, the implication of the "perverse" forecasting result identified by Shiller is that time-varying term premia do exist and are positively related to the slope of the yield curve. When the long-term rate exceeds the short-term rate, long-term bonds are priced by the market to provide an excess return that exceeds that implied by equation (1): that is, $E_t(H_t^{(n)}) = r_t + \phi_t^{(n)}$ and $\phi_t^{(n)} > \phi^{(n)}$ if $R_t^{(n)} > r_t$.[17]

Does this "perverse" forecasting relationship exist in the Canadian data, in both the pre- and post-shift periods? This question is readily answered. Regressions of the future change in the long-term rate on the current slope of the yield curve, for both Canada and corporate bonds, are presented in Table VI. For long-term Canada bonds, the relationship between the subsequent change in the long-term rate and the current slope of the yield curve is *negative* in the pre-shift, post-shift, and combined sample periods. In no sample period, however, is the

Table VI

The Predictive Content of the Slope of the Yield Curve[a]

Dependent Variable	Sample Period	Constant Term	Coefficient of $R_t^{(n)} - r_t$	R^2	S.E.E.	D.W.
1. $R_{t+1}^{(n)} - R_t^{(n)}$ (Canada bonds)	1957:1–1985:2	12.99 (0.92)	−0.061 (0.77)	0.015	69.94	2.17
2. " "	1957:1–1979:3	10.81 (1.71)	−0.021 (0.54)	0.004	36.13	1.73
3. " "	1979:4–1985:2	3.41 (0.11)	−0.132 (0.96)	0.040	141.51	2.33
4. $R_{t+1}^{(n)} - R_t^{(n)}$ (Corporate bonds)	1957:1–1985:2	19.61 (1.54)	−0.111 (1.74)	0.055	69.64	2.17
5. " "	1957:1–1979:3	14.82 (2.61)*	−0.055 (1.85)	0.046	31.71	1.56
6. " "	1979:4–1985:2	16.65 (0.46)	−0.185 (1.50)	0.083	144.72	2.31
7. $H_t^{(n)} - r_t$ (Canada bonds)	1957:1–1985:2	−441 (1.13)	2.717 (1.22)	0.033	2120	2.07
8. " "	1957:1–1979:3	−433 (1.71)	1.843 (1.19)	0.020	1446	1.73
9. " "	1979:4–1985:2	−92 (0.11)	4.563 (1.23)	0.064	3830	2.33
10. $H_t^{(n)} - r_t$ (Corporate bonds)	1957:1–1985:2	−617 (1.84)	4.181 (2.52)[a]	0.096	1945	2.06
11. " "	1957:1–1979:3	−558 (2.61)[a]	3.079 (2.74)[a]	0.095	1193	1.56
12. " "	1979:4–1985:2	−427 (0.46)	5.748 (1.82)	0.117	3711	2.31

[a] Interest rates and holding-period yields are expressed in basis points at annual rates. Figures in parentheses are t-statistics, after the standard errors have been corrected for heteroscedasticity. Asterisks indicate coefficients that are significantly different from zero at the 95% confidence level.

[16] Campbell and Shiller [2] find continuing evidence of this "perverse" forecasting relationship when they regress the excess monthly return on a twenty-year bond relative to a one-month bill on the long-short spread for the period 1955:1 to 1979:3. Shiller, Campbell, and Schoenholtz [19] find that this "perverse" relationship continues to hold when the U.S. data are updated through mid-1982.

[17] For a review of recent evidence regarding the existence of time-varying term premia, see Melino [9].

coefficient of the yield curve significantly different from zero at the five percent confidence level.[18] The results are similar for the long-term corporate bonds, although the negative relationship in the pre-shift and combined sample periods is now significant, but only at the ten percent level.

Regressions of the excess returns of these long-term bonds on the slope of the yield curve are also presented in Table VI. They, of course, provide similar results. In all cases, the slope coefficients are positive, indicating that excess returns vary positively with the long-short spread. The relationship is significant for the corporate bonds, but only in the pre-shift and combined sample periods. One cannot, however, reject the null hypothesis that the relationship between the excess return on corporate bonds and the slope of the yield curve is the same in the pre- and post-shift periods.[19] This suggests that the relationship may prove to be useful in a forecasting context. Further, the magnitude of the point estimate of the slope coefficient suggests that the relationship may be quantitatively important. In the pre-shift period, for which this point estimate is the smallest, it nonetheless equals 3.079. This implies that a one hundred-basis point increase in the long-short spread is associated with a 307.9-basis point increase in the excess return on long-term corporate bonds.

As highlighted by the excess-return regressions, even a small correlation between the future change in the long-term rate and the current slope of the yield curve may be important in an economic sense. It is thus instructive to determine whether the observed relationships are sufficiently stable so as to be useful in a forecasting context. From the perspective of this paper, a natural breakpoint in the sample is the apparent shift in the monetary regime that occurred in the third quarter of 1979. Equations 2 and 5 in Table VI were thus used to generate forecasts of the change in the long-term Canada and corporate rates, respectively, in the post-shift period. The root-mean-square errors of this forecasting procedure were then compared with those of the no-change prediction.

For both the Canada and corporate bonds, the predicted changes using the "slope" regressions are more accurate than the no-change predictions, but only modestly so. For the Canada bonds, the root-mean-square error for the period 1979:4 through 1985:2 is 137.7 basis points, compared with 139.4 basis points for the no-change prediction. For the corporate bonds, the corresponding figures are 141.8 basis point and 145.7 basis points.[20]

The predicted changes from the "slope" regressions are considerably more accurate than the recorded forecasts. For the McLeod, Young, Weir surveys, the

[18] This is the relevant benchmark, given our interest in looking for stable relationships that might prove useful in a forecasting context. One might also be interested, for example, in the size (and significance) of the slope coefficient relative to the value predicted by the rational-expectations model. See, for example, Shiller, Campbell, and Schoenholtz [19] and Pesando [15, footnote 7].

[19] We again used the Goldfeld-Quandt [5] test. For corporate bonds, the relevant test statistic, which is distributed $F(2, 110)$, equalled 0.409. One cannot reject the null hypothesis of an unchanged relationship for Canada bonds as well ($F(2, 110) = 0.392$). This latter result is less interesting in view of the lack of statistical significance of the slope coefficients.

[20] There is no improvement in the forecasting performance if the 1957:1 through 1979:3 "slope" regression for corporate bonds is updated each time an additional observation becomes available and is then used to make a forecast for the subsequent quarter.

root-mean-square error of the one-quarter-ahead forecasts of the corporate rate for the period 1979:4 through 1982:4 (the period for which the survey data are available) equals 193.3 basis points, compared with 174.7 basis points for the "slope" regression. For the one-quarter-ahead DRI forecasts of the Canada rate, the margin of superiority for the "slope" regression is 107.9 basis points to 124.4 basis points,[21] and so on.

It is also instructive to examine the relationship between the change in the long rate implicit in the recorded forecasts and the slope of the yield curve. Regressions of the one-quarter-ahead and two-quarters-ahead implicit forecasts of the change in the long-term rate on the current slope and the one-quarter-ahead forecast slope of the yield curve, respectively, are presented in Table VII. Interestingly, in the two cases in which a significant relationship exists, it is in the direction required by the rational-expectations model. When the long rate exceeds the short rate, the forecast is that the long rate will rise, and conversely. However, as the results in Table VI show, this is not the relationship that exists in the actual data.

Following Shiller [18], there has been considerable attention devoted to the long-short spread, either as a predictor of future changes in the long-term rate or as a determinant of excess returns. There is, of course, no need to constrain the coefficient of the long-term rate to be equal in magnitude but opposite in sign to that of the short-term rate. Indeed, there is substantial literature that has

Table VII

The Recorded Forecasts and the Slope of the Yield Curve[a]

Dependent Variable	Forecaster	Constant Term	Coefficient[b] of $R_t^{(n)} - r_t$	R^2	Sample Period
1. $E_t\,(R_{t+1}^{(n)}) - R_t^{(n)}$	Conference Board	−5.89	−0.04	0.018	1975:1–1984:4[c]
(Corporate bonds)		(0.41)	(0.71)		
2. " "	Data Resources Inc.	−36.65	0.15	0.156	1975:2–1985:2
		(2.66)*	(2.58)*		
3. " "	McLeod, Young, Weir	−25.17	0.01	0.000	1974:4–1982:4
	surveys	(1.97)	(0.12)		
4. $E_t\,(R_{t+1}^{(n)}) - R_t^{(n)}$	Data Resources Inc.	−17.80	0.09	0.052	1975:2–1985:2
(Canada bonds)		(1.73)	(1.46)		
5. $E_t\,(R_{t+2}^{(n)} - R_{t+1}^{(n)})$	Conference Board	−0.64	−0.04	0.078	1975:1–1984:4[c]
(Corporate bonds)		(0.15)	(1.56)		
6. " "	Data Resources Inc.	−13.46	0.02	0.024	1975:2–1985:2
		(3.09)*	(1.07)		
7. " "	McLeod, Young, Weir	−12.96	0.06	0.204	1974:4–1982:4
	surveys	(2.52)*	(2.28)*		
8. $E_t\,(R_{t+2}^{(n)} - R_{t+1}^{(n)})$	Data Resources Inc.	−13.81	0.04	0.035	1975:2–1985:2
(Canada bonds)		(3.00)*	(1.31)		

[a] Figures in parentheses are t-statistics, after standard errors have been corrected for heteroscedasticity. Asterisks indicate coefficients that are significantly different from zero at the 95% level.

[b] For equations 5 through 8, this "slope" variable equals $E_t\,(R_{t+1}^{(n)} - r_{t+1})$.

[c] Observations for 1979:2 and 1981:3 were unavailable.

[21] Because DRI and the Conference Board forecast the average value of the interest rate during the quarter, the regressions were rerun with quarterly averaged data and then used to generate the corresponding out-of-sample forecasts.

investigated the relationship between term premia and the *level* of interest rates. (See, for example, Kane [6] and Pesando [12] for empirical evidence of such a relationship.) When we relax the coefficient constraint in Table VI, we find that it is decidedly rejected in the post-shift period but not in the pre-shift period.[22] When this constraint is relaxed and the reestimated equations for the period 1957:1 to 1979:3 are used to generate out-of-sample forecasts, we obtain results that are virtually identical to those presented earlier. For Canada bonds, the root-mean-square error for the period 1979:4 through 1985:3 is 137.7 basis points, the same as before; for corporate bonds, it is 142.7 basis points, up slightly from 141.8 basis points.

IV. The Time-Varying Term Premium Associated with the Slope of the Yield Curve

Under the assumption that economic agents form rational expectations, the results in Table VI suggest that the time-varying term premium $\phi_t^{(n)}$ in equation (1′) varies with the long-short spread. This raises two distinct questions. First, how quantitatively important are the implied short-run movements in $\mathrm{E}_t(H_t^{(n)})$? Second, does the replacement of $\phi^{(n)}$ in (1) with $\phi_t^{(n)}$ in (1′) resurrect the "forecastability" of short-term movements in long-term interest rates? More precisely, if $\phi_t^{(n)}$ depends on the slope of the yield curve according to the point estimates in Table VI, do the rationally anticipated changes in the long-term rate remain "small"?

It is straightforward to calculate the means and standard deviations of the $\phi_t^{(n)}$ implicit in Table VI. These, in turn, provide a useful perspective on the importance of the movements in $\mathrm{E}_t(H_t^{(n)})$ implied by equation (1′). Based on the point estimates for the sample period 1957:1 through 1985:2 (i.e., lines 7 and 10 of Table VI), the results are as follows. For Canada bonds, the term premium ranges from −1620 to 632 basis points and has a mean of −139 basis points and a standard deviation of 386 basis points. For the corporate bonds, this term premium ranges from −2344 basis points to 1406 basis points and has a mean of −93 basis points and a standard deviation of 631 basis points. In short, $\phi_t^{(n)}$ *does* vary substantially from quarter to quarter, implying corresponding movements in $\mathrm{E}_t(H_t^{(n)})$.

The primary concern of the present paper is with the "forecastability" of short-term movements in long-term interest rates. By replacing $\phi^{(n)}$ in equation (6) with our estimates of $\phi_t^{(n)}$, we can readily identify the anticipated changes in the long-term rate associated with the model summarized by equation (1′). These

[22] For equations (3), (6), (9) and (12) in Table VI, the coefficient constraint is rejected at the one percent level. Although the coefficients do have opposite signs, the coefficient of the long rate is always much larger in absolute value.

We again tested for structural breaks associated with other shifts in the U.S. monetary regime. Only the results for the subperiod 1982:4 through 1985:3 differ sharply from the rest. During this period, for example, the long-short spread explains 26.5 percent and 23.7 percent of the variance in the excess returns on Canada and corporate bonds, respectively. When the coefficient constraint is relaxed, these figures rise to 46.8 percent and 44.8 percent. These results have no persuasive economic interpretation and would appear to be a statistical anomaly.

results are summarized in Table VIII. For the Canada bonds, the mean absolute change rises from 2.14 to 6.18 basis points in the pre-shift period and from 6.19 to 14.34 basis points in the post-shift period.[23] For the corporate bonds, the corresponding increases are from 2.58 to 9.41 basis points and from 7.02 to 22.95 basis points. It is particularly instructive to compare the results in Table VIII with those in Table I. When $\phi_t^{(n)}$ replaces $\phi^{(n)}$, the mean absolute values of the anticipated change in the long-term rate more than double in both the pre-shift and post-shift periods. In spite of this fact, the anticipated changes in the long-term rate remain "small" relative to actual changes. In the post-shift period, for example, the ratio of the variance of anticipated to actual changes is 0.94 percent for Canada bonds and 3.76 percent for corporate bonds. These figures thus indicate that observed movements in long-term rates continue to be dominated by the noise associated with the arrival of new information, even when a time-varying term premium linked to the slope of the yield curve is presumed to exist. More precisely, 99.06 percent of the variance of the change in the long-term Canada rate is due to the receipt of new information, as is 96.24 percent of the variance of the change in the corporate bond rate.

V. Summary and Conclusions

The substantive results contained in this paper can be summarized succinctly. First, in spite of the increase in both the level and the volatility of interest rates in Canada following the October 1979 shift in the monetary regime in the United

Table VIII

Actual and Anticipated Changes in Long-Term Interest Rates When There is a Time-Varying Term Premium[a]

	Canada Bonds		Corporate Bonds	
	Anticipated	Actual	Anticipated	Actual
Period 1957:1 through 1979:3				
Mean Absolute Change	6.18	26.51	9.41	23.33
Maximum Absolute Change	15.53	127.00	28.56	119.00
Mean Change	5.34	7.04	5.04	6.45
Standard Deviation	4.67	34.84	10.41	30.82
Period 1979:4 through 1985:3				
Mean Absolute Change	14.34	108.67	22.95	113.13
Maximum Absolute Change	43.84	263.00	75.31	316.00
Mean Change	14.34	2.42	12.72	2.38
Standard Deviation	13.51	139.39	28.27	145.83

[a] Time-varying term premiums for Canada and corporate bonds are based on point estimates contained in lines 7 and 10, respectively, of Table VI, together with the contemporaneous spread between the relevant long- and short-term rates.

[23] In the post-shift period, *both* the mean anticipated change and the mean absolute value of the anticipated change equal 14.34 basis points. This indicates that all of the anticipated changes are positive. During this post-shift period, the mean value of the term premium is −357 basis points, and this is apparently sufficient to ensure—at the start of each quarter—that the rational forecast is for the long-term Canada rate to rise.

States, the anticipated quarterly changes in Canadian long-term rates implied by the rational-expectations model remain "small." This suggests that the no-change prediction remains a close approximation to the rational-expectations model, at least over quarterly forecast horizons. Second, recorded forecasts of long-term interest rates in Canada during this post-shift period prove to be less accurate than the no-change prediction. Third, these recorded forecasts of the *level* of long-term rates imply forecast *changes* in these rates far in excess of those associated with the rational-expectations model. The implication is that the excess return on long-term relative to short-term bonds is forecast to vary over a wide range.

Such variation may be associated with a belief that time-varying term premia contribute importantly to movements in long-term interest rates.[24] There is little in the *performance* of the recorded forecasts, however, to suggest that the systematic element of a term premium—if it exists—has been identified by the forecasters.

Finally, in both the pre- and post-shift periods, subsequent movements in long-term rates are *negatively* correlated with the long-short spread. This is, of course, the opposite of the relationship implied by the rational-expectations model. Under the assumption that economic agents form rational expectations, this result implies that time-varying term premia do exist and are positively related to the slope of the yield curve. Alternatively, the slope of the yield curve may serve as a proxy for more plausible determinants of the term premia, including those suggested by the CAPM. Especially for corporate bonds, these term premia are important, as they result in substantial quarter-to-quarter variation in the excess return on long-term bonds. Nonetheless, these term premia resurrect the "forecastability" of short-term movements in long-term interest rates in only a modest way, as anticipated changes in the long-term rate remain small relative to actual changes. When pre-shift estimates of the slope coefficients are used to generate forecasts of the change in the long rate in the post-shift period, the results are only a modest improvement over the no-change prediction.

[24] It is useful to compare these results with those of Kane [6], who also examines survey data on interest rate forecasts. Kane concludes that time-varying term premia do exist and vary positively with the level of interest rates. Kane further observes that the variation in term premia is small relative to observed quarter-to-quarter changes in long-term rates. Tables I and IV in the present study provide a similar message. The recorded forecasts of the change in the long-term rate are large relative to those associated with the rational-expectations model. Under the null hypothesis of market efficiency, these forecasters are trying to anticipate (in the main) future movements in term premia. Nonetheless, these forecast changes remain considerably smaller than the observed changes in the respective long-term rates.

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