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BEHAVIOR IN PERSPECTIVE:
SOME DESCRIPTIVE STATISTICS

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Research Paper

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RECENT INTEREST RATE BEHAVIOR IN PERSPECTIVE: SOME DESCRIPTIVE STATISTICS

This paper reports measures of (1) interest rate volatility, (2) the strength of the relation between the federal funds rate and other rates, and (3) intraweek interest rate cycles. Interest rate behavior in the three years after the October 1979 change in Federal Reserve operating policy is compared and contrasted with that during prior years, to place recent volatility in perspective.

This study is primarily descriptive rather than analytical. Results presented can be understood without knowledge of highly sophisticated statistical techniques or economic theories, and should be of interest to money market participants as well as economists. However, the results suggest a need for further analysis along theoretical lines to explain the surprisingly closer relation in recent years between the federal funds rate and longer-term interest rates. Whatever the explanation, the increased instability in the funds rate has apparently spilled over to longer-term rates to an unexpectedly large degree. This is clearly an unfortunate aspect of the new operating procedure.

By all measures, interest rates became more volatile in the first year following the policy shift. The volatility of short-term rates declined by the third year, however. Indeed, by some measures, the volatility of the funds rate was lower in more recent months than during the seventies as a whole. The decline in volatility by fiscal year 1982 was less marked for issues with three-month or one-year terms. Long-term rates, surprisingly, have declined little in volatility, displaying an instability consistently above that of the seventies.

Fluctuations in all interest rates, but especially long-term rates, displayed increased correlations with funds rate fluctuations at daily and weekly frequencies. These correlations have increased in fiscal 1982 relative to fiscal 1980. Two possible explanations for the higher correlation are available: (1) the unpegging of the funds rate has freed it to move in tandem with other rates, and (2) other interest rates have become more sensitive to the federal funds rate.

One sign that the money market had difficulty adapting to the general increase in interest rate volatility is the magnification of intraweek interest rate cycles in the first two years of the new policy. Although there is evidence that this cycle more recently attenuated and altered its character in the federal funds market, and dampened in short-term securities markets, it continued to wax in the long-term markets.

Federal Funds Rate Volatility

Several alternative measures of interest rate volatility can be employed. One is the standard deviation of first differences of the interest rate, in basis points. Another is the standard deviation of first differences in the natural log of the interest rate. The latter measure gives less weight to a given absolute change at higher levels, and measures proportional variation. The choice between these measures makes a substantial difference for the present analysis, because the shift in procedure was accompanied by a substantial increase in the level of rates.

When measured in basis points, the funds rate volatility in the wake of the change in procedure was unprecedented at daily, weekly, and monthly frequencies. As shown in Table 1, the standard deviation of first differences rose to 81, 82, and 192 basis points in the 1980-1982 fiscal year¹/ period, for daily, weekly, and monthly intervals, respectively. These measures of dispersion greatly exceeded even their levels of the earlier seventies, when the funds rate targeting procedure was not fully refined. These levels of volatility were 114 percent, 504 percent, and 704 percent higher than for the 1977-1979 fiscal years, and 93 percent, 245 percent, and 288 percent above the 1971-1979 base period. There was less volatility in fiscal years 1981 and 1982 than in 1980, especially at daily and monthly frequencies. Daily volatility in fiscal 1982 fell to 56 basis points, which was below that of fiscal years 1973, 1974, and 1975. But weekly volatility, measured in basis points, while receding somewhat, was still well above that of any years in the seventies.

Measured in terms of changes in the natural log, volatility increased 72 percent, 224 percent, and 285 percent from fiscal years 1977-1979 to 1980-1982, for daily, weekly, and monthly data, respectively, as shown in Table 2. But using the entire 1971-1979 period as a basis for comparison, volatility actually fell by 15 percent for daily data, and rose by only 58 and 89 percent for weekly and monthly intervals. Only for monthly data was the post-shift volatility in logarithmic differences completely unprecedented in the seventies. Daily volatility in 1980-1982 was below that of the years 1971 through 1976. Daily volatility in 1982 was even lower, and only slightly above that of 1979, the last year of the funds rate targeting procedure. Weekly volatility in 1980 and 1981 was above that of any year in the seventies except 1971, and remained high in 1982.

An interesting, yet unresolved question relates to the reason for the decline in daily funds rate volatility in the last two years. At least three potential explanations are available. First, the Federal Reserve may have to some degree reallocated attention back to interest rates and away from reserve aggregates as guides to open market strategy. Second, the shocks arising from the macroeconomy, the credit markets (including the 1980 controls) and the reserve market (such as float) may have declined in magnitude. Third, banks and other money market participants may have adapted, if slowly, to the new environment. Such adaptation could smooth the response of the funds rate to these shocks by altering the timing of discount window borrowing or by prompting more opportune use of carryover provisions and "as-of adjustments" to reserves. All three explanations

appear reasonable and compatible, but testing them goes beyond the scope of this investigation.

Other Short-Term Rates

Whether measured in basis points or logarithms, the volatility of commercial paper and Treasury bill yields rose after October 1979 to levels never approached in the seventies. As shown in Table 3, the standard deviation of daily, weekly, and monthly first differences of the three to four month commercial paper yield (discount basis), in basis points, rose 538 percent, 497 percent, and 425 percent, respectively, in 1980-1982, compared with the previous three years. The increase over the 1970s as a whole was less, again reflecting the particular stability of rates during the late period of funds rate targeting. Although commercial paper rates increased in variability in the second year of the new procedure as compared with the first, they stabilized somewhat in fiscal 1982. But even the 1982 volatility was far above that experienced in the seventies.

Three-month Treasury bills are often used as a means of reserve adjustment by banks. As shown in Table 5, their quoted yields displayed an increase in volatility of 240 percent, 284 percent, and 449 percent, in basis points, for daily, weekly, and monthly frequencies, respectively, in 1980-1982 as compared with 1977-1979. The increase is less substantial if the 1971-1979 period is used as a base, or if logged data are employed, as in Table 6. As in the case of commercial paper of comparable maturity,

volatility increased in both 1980 and 1981 before receding in 1982. In log terms, the recent volatility was unknown in the seventies for weekly and monthly frequencies but similar to that of 1974 and 1975 for daily data. Furthermore, even at monthly and weekly frequencies, the log measure of variability recently has been only moderately above that of some years in the early seventies.

The yield on one-year bonds displayed a similar pattern of volatility, as shown in Tables 7 and 8.

Long-Term Rates

Surprisingly, the proportional increase in volatility of long-term rates, as shown in Tables 9 through 14, was even greater than for the funds rate at daily frequencies. For example, the basis-point measure of daily volatility rose 310 percent for 10-year Treasury bond yields and 270 percent for 5-year Treasury bond yields, compared with only 114 percent for the federal funds rate. For weekly measures, the increase for 10-year and 5-year Treasury issue yields was 328 percent and 293 percent, less than the 504 percent increase in funds rate variability. For the Moody's index of AAA corporate bond yields, the increase was 443 percent, nearly matching the proportional increase in funds rate volatility. Indeed, the volatility in long-term rates has not dampened in 1981 and 1982 from the first year of the new operating policy, as has volatility in short-term rates. Consequently, daily volatility for 1982 was, when compared with the 1977-1979 base period, 296 percent higher for 10-year bonds while only 115 percent higher for the funds rate. Although the hope was widespread that

would stabilize as money market participants learned to deal in the new policy environment, this apparently has not occurred. The continued great volatility of long-term rates calls for further investigation beyond our scope.

In the present context, it seems especially important to establish whether the increased volatility of long rates can be attributed to that of the funds rate. If so, the recent volatility could be ascribed to the new operating policy. If, however, the long-term interest rate volatility is due to other factors, the new policy would bear no such responsibility. This consideration motivates a study of the relation between funds rate changes and movements in other rates.

Interest Rate Linkages

Other interest rates, especially long-term rates, displayed an unexpected increase in sensitivity to the funds rate after the change in policy--particularly at daily frequencies, but also at weekly frequencies. This heightened sensitivity is revealed both by slope coefficients in regression of changes in various other rates on those of the funds rate, and also by correlation coefficients of such changes. Formally, let R be the interest rate whose sensitivity to fluctuations in the funds rate, denoted r, was examined. The regression equation fitted was:

$$\Delta \ln R_t = \hat{\alpha} + \hat{\beta} \Delta \ln r_t$$

where t is a daily, weekly, or monthly time subscript. The ordinary least squares regression methodology was applied for each year, each interest rate (other than the funds rate itself), and for all three frequencies of

data. From the results, recorded in Tables 15 through 19, were derived slope coefficients ($\hat{\beta}$ s), measures of the strength of the relations, and correlation coefficients ($\hat{\rho}$ s), measures of the closeness of the relations.

For all interest rates examined, both $\hat{\beta}$ and $\hat{\rho}$ rose substantially in fiscal 1980 for both weekly and daily data. Although they fell somewhat in 1981, they rose to new records in fiscal 1982. Daily data were virtually uncorrelated over the seventies, but in 1982, $\hat{\rho}$ varied from .21 for 10-year bonds to .47 for three to four month commercial paper yields. The most surprising result is the high correlation of long-term bond yields with even daily funds rate fluctuations.

The higher correlations between changes in the funds rate and changes in other rates can arise both because:

- (a) changes in reserve market conditions (reflected in the funds rate) cause changes in credit market conditions (reflected in other rates),
- and (b) changes in credit market conditions cause changes in reserve market conditions.

The distinction between these (not mutually exclusive) explanations is important for evaluating the new procedure. To the extent that changes in money and credit demand more automatically result in funds rate movements under the new procedure, the closer parallelism of interest rates reflects an appropriate response of the funds rate to those conditions, rather than constituting an independent source of instability.

Theoretical arguments suggest that explanation (b) is less important than (a). The system of lagged reserve requirements largely severs the automatic response of the funds rate to money and credit demands

over periods of up to two weeks. An increase in the demand for money and credit will generally lead to a rise in bank deposits, thus raising the demand for reserves and an automatic rise in the funds rate under the new operating policy. However, lagged reserve requirements delays the increase in reserve demand for two weeks. (This argument is developed in detail in Hoehn [6], Laurent [8], and Hetzel [5].)

Tempering this conclusion is a mechanism operating through expectations. Banks facing greater demand for loans and/or higher security yields might expect increases in the funds rate in the weeks ahead, leading them to desire to postpone use of their discount window borrowing privileges. This would lead to an immediately higher funds rate as banks attempt to acquire reserves in the federal funds market instead of the discount window. However, it is not clear that expectations would be affected in the necessary manner within a week, both because aggregate monetary and credit figures are available only after a delay, and because a rise in (immediately observable) security yields could precede either a rise or fall in the funds rate in future weeks. Consequently, a priori reasoning suggests that the higher correlation between funds rate fluctuations and those of other rates, for periods of up to two weeks, are primarily due to a spillover of reserve market instability.

This theoretical hypothesis can be tested by statistical time-series methods, such as the Price-Haugh independence test.^{2/} This test evaluates the relation across time of "innovations" in two series. Innovations are the residuals of univariate autoregressive-integrated-moving average models chosen so that the residuals contain no autocorrelation.

The evidence from such tests is mixed, but offers support for both explanations (a) and (b), contrary to a priori expectations. Innovations in the daily commercial paper rate are statistically related to past funds rate innovations but not future funds rate innovations, supporting explanation (b) and failing to support explanation (a). On the other hand, a similar test using the ten-year Treasury bond rate supports (a) but not (b). Both explanations are supported by a test with the three-month Treasury bill rate.

In conclusion, it is likely that increased weekly funds rate volatility has spilled over to other rates, yet, at the same time, much of the increased funds rate volatility may reflect more rapid and appropriate responses to money and credit market developments. This responsiveness was a goal--perhaps the major goal--of the change in operating procedure.

Intraweek Interest Rate Cycles

A little-noticed phenomenon in the money market is the persistent tendency of certain interest rates, particularly the federal funds rate, to move in a systematic fashion within a week. For example, the federal funds rate has been higher, on average, on Fridays and Mondays than on Wednesdays. This pattern, documented in Tables 21 through 28, probably reflects risk-averse management of bank reserve positions. A bank needs to meet its reserve requirements only on a weekly average basis. Given the uncertainty surrounding end-of-week reserve flows and the funds rate, a risk-averse reserve position manager might prefer to hold an oversufficiency of reserves during the earlier days of the reserve

maintenance week, which ends on Wednesday. Such a tactic provides protection against the need to borrow heavily to cover a reserve outflow that occurs late in the week. On Wednesday, the final day of reckoning, the funds market is extremely volatile, and trading later in the afternoon becomes thin. Banks have sometimes acquired funds late Wednesday at rates far above the day's average, or found insufficient funds offered at any price. Because of the tendency to desire larger reserve holdings earlier in the week, a higher funds rate is needed then to ration the available reserve supply. Under the new procedure, supply tends to be less dependent on the day of the week. Under the old procedure, the intraweek funds rate cycle was constrained in large degree by operating policy. The weekly average funds rate target could have been achieved without eliminating the intraweek cycle, but even then, the assurance of a closely administered funds rate eliminated much of the risk which gave rise to that cycle. Under the new policy, one would expect increased funds rate volatility to imply a more pronounced intraweek cycle, for a given degree of risk aversion.

The evidence suggests that in the 1980-1981 period, the federal funds rates' intraweek cycle was distended by the shift in policy. But there is also some evidence that this cycle has dampened and altered in its contour during more recent months.

The average change in basis points for each day of the week during several sample periods is reported in Tables 21 through 25. (Days following holidays in which the market was closed have been excluded, because they do not reflect a single day's effect, but that of two or more days.) The mean change for Thursday deserves special attention, since it

reflects the difference between the end of one week and the beginning of the next week, when uncertainty about end-of-week reserve positions is the greatest.

In the two years immediately prior to the policy change the funds rate, on average, rose 12 basis points on Thursday, held steady on Friday, and climbed another 8 basis points on Monday. It fell 5 points on Tuesday and 12 points on Wednesday. As in other sample periods, volatility, expressed in terms of standard deviations, was greatest on Wednesdays and Thursdays and smallest on Fridays.

During the following two years, the same basic pattern was repeated, but with considerable magnification. The funds rate rose an average of 61 basis points on Thursday, and fell 22 basis points and 40 basis points on Tuesday and Wednesday, respectively. In 1980, the average Thursday increase was a staggering 72 basis points, followed by further increases on Friday and Monday. By 1981, the typical Thursday rise was reduced to 50 basis points, which was followed by a substantial drop on Fridays. For 1982, the cycle was weaker and inverted. The funds rate on average rose a fraction of a point on Thursday, fell 23 points on Friday, and rose 10 points on Wednesday. The correlation coefficient, which measured over a half in 1980, fell to a fifth by 1982 (Table 27). The dampening and different pattern in the intraweek cycle likely reflect the result of a "learning process." Banks learned of the opportunity to meet reserve requirements at lower cost late in the week. In view of the substantial difference in 1980 between the level of the funds rate early versus late in the week, banks had substantial incentives to alter their practice of maintaining higher reserve positions early in the week.

The Treasury bill rate has also displayed an intraweek cycle, with a contour that is consistent with the foregoing hypothesis of reserve position management. Treasury bills are used extensively in bank reserve management, because of their liquidity. Bills are liquid "reserves" secondary only to federal funds. A desire for reserves tomorrow can be satisfied by a sale of bills today. A bank often disposes of bills toward the end of the week in order to acquire legal reserves. It should do so by Tuesday, however, since such transactions are typically made for next-day settlement. Consequently, bill rates tend to sustain upward pressure on Tuesdays and Mondays when compared with Wednesdays and Thursdays. One would expect the intraweek bill rate cycle to be directly related to the same uncertainty, which in conjunction with risk-aversion, generates the funds rate cycle.

Other interest rates also display an intraweek cycle. Rates on issues of terms ranging from one year to ten years tend to rise on Thursday, fall on Friday, rise again on Monday, and show mixed patterns on Tuesday and Wednesday. Risk-averse security dealers and speculators may wish to reduce exposure to Friday money announcements by selling securities on Thursday and buying them back on Friday afternoon. But this is an incomplete explanation. Research into security dealer behavior might prove fruitful in explaining the pattern observed.

What is most interesting in this context is that the intraweek cycle, while weakening in 1981 and 1982 for short-term interest rates, has continued to strengthen for long-term bond yields, as shown in Tables 27 and 28.

Note on Data Sources

Most monthly and daily interest rate data prior to 1982 were obtained from the Macro Data Library computer file of the Board of Governors of the Federal Reserve System. Some of those data were altered to conform with figures in various issues of the Federal Reserve Bulletin. Data for more recent months (beginning in April, May, or June of 1982) were obtained from Federal Reserve H.15 statistical releases. Weekly federal funds rate variability was measured using Thursday through Wednesday averages, which conform to reserve statement weeks. Regressions employing weekly data used Monday through Friday averages for federal funds. Friday federal funds figures were triple-weighted and pre-holiday figures double-weighted in constructing weekly averages.

FOOTNOTES

1. "Fiscal years" are regarded here as starting October 1 and ending September 30, even though the U.S. Government did not consistently employ this definition in the seventies.

2. The method of this test is described in Haugh [4]. Essentially, univariate time-series models, which account for autocorrelation, are fitted for each of two series, and residuals extracted. These two residual series are free of autocorrelation and can be cross-correlated at various lags to make valid tests of independence. Tests of bivariate "Granger causality" with lag lengths of twelve days (see Granger and Newbold [2]) yielded the result that the funds rate both "caused" and was "caused by" each of the three interest rates used in the Pierce-Haugh tests.

Table 1.
STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE
FEDERAL FUNDS RATE, IN BASIS POINTS

<u>Fiscal Year(s)</u>	<u>Frequency</u>		
	<u>Daily</u>	<u>Weekly</u>	<u>Monthly</u>
1971	38.5	29.3	45.7
1972	29.1	16.8	39.8
1973	59.0	31.5	57.4
1974	60.3	36.4	73.3
1975	62.0	27.5	63.5
1976	25.7	12.9	28.1
1977	16.9	11.6	26.4
1978	9.6	9.8	15.0
1979	38.1	18.2	26.7
1980	92.6	94.8	241.5
1981	92.2	86.4	204.8
1982	55.6	83.2	113.7
1971-1979	42.1	23.8	49.5
1977-1979	25.9	13.6	23.9
1980-1982	81.3	82.2	192.1

Table 2.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE
 NATURAL LOG OF THE FEDERAL FUNDS RATE
 (Figures are Multiplied by 100)

Fiscal Year(s)	Frequency		
	Daily	Weekly	Monthly
1971	9.22	6.86	9.69
1972	7.17	4.22	9.70
1973	7.45	3.78	5.77
1974	6.25	3.24	6.77
1975	10.09	3.95	8.46
1976	5.93	2.43	5.24
1977	3.49	2.24	5.10
1978	1.27	1.35	2.04
1979	3.82	1.83	2.80
1980	7.26	7.16	17.69
1981	5.40	5.28	12.80
1982	4.12	6.25	8.98
1971-1979	6.67	3.70	7.15
1970-1979	3.31	1.80	3.51
1980-1982	5.70	5.84	13.53

Table 3.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE 3 TO 4 MONTH
COMMERCIAL PAPER RATE, IN BASIS POINTS

Fiscal Year(s)	Frequency		
	Daily	Weekly	Monthly
1971*	5.61	8.9	21.7
1972	5.23	10.7	34.8
1973	6.30	14.9	39.5
1974	11.71	28.3	73.6
1975	9.25	25.7	79.7
1976	6.27	12.7	34.6
1977	4.41	9.5	24.7
1978	2.61	6.5	20.9
1979	5.69	17.0	50.4
1980	27.33	71.7	229.6
1981	32.54	80.6	176.3
1982	25.18	60.3	132.2
1971-1979	6.95	17.4	52.0
1977-1979	4.46	11.9	34.7
1980-1982	28.47	71.0	182.3

* Last 23 weeks only

Table 4.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE NATURAL LOG
OF THE 3 TO 4 MONTH COMMERCIAL PAPER RATE
(Figures are Multiplied by 100)

Fiscal Year(s)	Frequency		
	Daily	Weekly	Monthly
1971*	1.09	1.71	3.99
1972	1.15	2.37	7.65
1973	0.83	1.74	4.50
1974	1.19	2.86	7.73
1975	1.27	3.33	9.72
1976	1.13	2.25	6.10
1977	0.86	1.82	4.76
1978	0.37	0.87	2.83
1979	0.56	1.68	5.01
1980	2.41	5.85	18.53
1981	2.05	5.11	11.48
1982	2.04	4.19	10.40
1971-1979	0.99	2.28	6.74
1977-1979	0.63	1.52	4.25
1980-1982	2.17	5.30	13.83

* Last 23 weeks only

Table 5.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE THREE-MONTH
TREASURY BILL RATE, IN BASIS POINTS

<u>Fiscal Year(s)</u>	<u>Frequency</u>		
	<u>Daily</u>	<u>Weekly</u>	<u>Monthly</u>
1971	6.49	19.0	49.1
1972	6.47	14.6	34.8
1973	9.56	25.7	35.5
1974	19.27	39.2	74.2
1975	13.61	23.9	47.8
1976	5.40	12.1	28.1
1977	4.94	9.1	24.6
1978	6.80	12.5	25.9
1979	11.82	24.3	33.6
1980	27.47	63.7	189.4
1981	32.88	69.1	136.4
1982	25.54	55.9	129.2
1971-1979	10.45	21.9	43.0
1977-1979	8.36	16.6	28.2
1980-1982	28.45	63.6	154.5

Table 6.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE NATURAL LOG
OF THE THREE-MONTH TREASURY BILL RATE
(Figures are Multiplied by 100)

<u>Fiscal Year(s)</u>	<u>Frequency</u>		
	<u>Daily</u>	<u>Weekly</u>	<u>Monthly</u>
1971	1.77	4.21	11.01
1972	1.76	3.91	9.04
1973	1.35	3.49	4.76
1974	2.45	4.90	9.36
1975	2.16	3.83	7.72
1976	1.02	2.28	5.21
1977	1.01	1.88	5.09
1978	1.02	1.88	3.73
1979	1.35	2.81	3.67
1980	2.52	5.94	17.58
1981	2.26	4.77	9.73
1982	2.40	5.17	11.45
1971-1979	1.61	3.40	7.19
1977-1979	1.14	2.22	4.14
1980-1982	2.37	5.37	13.41

Table 7.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE
ONE-YEAR TREASURY BOND YIELD, IN BASIS POINTS

Fiscal Year(s)	Frequency		
	Daily	Weekly	Monthly
1971	5.19	21.4	55.5
1972	5.18	13.9	32.2
1973	6.70	17.4	42.0
1974	11.67	26.2	55.3
1975	9.76	21.9	58.5
1976	7.74	16.2	40.4
1977	5.77	10.9	28.2
1978	4.91	10.0	18.1
1979	8.30	17.9	41.7
1980	25.37	61.3	184.2
1981	28.51	52.9	100.9
1982	24.15	50.8	120.0
1971-1979	7.77	18.1	43.7
1977-1979	6.36	13.4	30.6
1980-1982	25.65	55.7	140.6

Table 8.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE NATURAL LOG
OF THE ONE-YEAR TREASURY BOND YIELD
(Figures are Multiplied by 100)

Fiscal Year(s)	Frequency		
	Daily	Weekly	Monthly
1971	1.10	4.14	11.32
1972	1.10	2.93	6.60
1973	0.91	2.30	5.72
1974	1.40	3.21	7.03
1975	1.44	3.26	8.43
1976	1.21	2.50	6.22
1977	1.05	1.97	5.13
1978	0.64	1.34	2.44
1979	0.83	1.81	4.24
1980	2.20	5.15	15.78
1981	1.95	3.63	6.95
1982	1.87	3.87	8.86
1971-1979	1.15	2.74	6.78
1977-1979	0.84	1.72	4.02
1980-1982	1.98	4.30	11.20

Table 9.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE FIVE-YEAR
TREASURY BOND YIELD, IN BASIS POINTS

<u>Fiscal Year(s)</u>	<u>Frequency</u>		
	<u>Daily</u>	<u>Weekly</u>	<u>Monthly</u>
1971	3.58	18.5	45.4
1972	3.57	8.3	18.5
1973	5.28	12.7	29.8
1974	6.42	14.1	28.7
1975	6.27	14.5	36.1
1976	5.08	9.5	19.0
1977	5.70	12.0	26.7
1978	3.26	7.1	13.3
1979	5.30	9.5	18.9
1980	18.13	42.8	116.5
1981	19.14	34.5	51.3
1982	16.72	36.2	80.4
1971-1979	5.5	12.2	28.0
1977-1979	4.8	9.8	20.5
1980-1982	17.7	38.4	89.1

Table 10

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE NATURAL LOG
OF THE FIVE-YEAR TREASURY BOND YIELD
(Figures are Multiplied by 100)

<u>Fiscal Year(s)</u>	<u>Frequency</u>		
	<u>Daily</u>	<u>Weekly</u>	<u>Monthly</u>
1971	0.61	3.03	7.67
1972	0.61	1.41	3.10
1973	0.74	1.75	4.23
1974	0.83	1.82	3.84
1975	0.81	1.90	4.67
1976	0.67	1.24	2.49
1977	0.86	1.81	4.07
1978	0.41	0.90	1.69
1979	0.59	1.05	2.09
1980	1.59	3.76	10.46
1981	1.40	2.56	3.76
1982	1.21	2.58	5.71
1971-1979	0.77	1.76	4.10
1977-1979	0.62	1.32	2.81
1980-1982	1.38	3.05	7.32

Table 11.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF MOODY'S
AAA CORPORATE BOND YIELD, IN BASIS POINTS

<u>Fiscal Year(s)</u>	<u>Frequency</u>	
	<u>Weekly</u>	<u>Monthly</u>
1971	6.7	19.7
1972	2.6	5.8
1973	3.2	8.6
1974	3.9	10.4
1975	5.4	16.6
1976	3.8	9.3
1977	4.0	9.2
1978	4.0	10.0
1979	4.8	12.1
1980	22.5	69.2
1981	21.2	41.2
1982	25.7	60.6
1971-1979	4.6	13.1
1977-1979	4.4	11.3
1980-1982	23.7	60.8

Table 12.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE NATURAL LOG
OF MOODY'S AAA CORPORATE BOND YIELD
(Figures are Multiplied by 100)

<u>Fiscal Year(s)</u>	<u>Frequency</u>	
	<u>Weekly</u>	<u>Monthly</u>
1971	0.89	2.62
1972	0.36	0.79
1973	0.42	1.15
1974	0.47	1.20
1975	0.61	1.86
1976	0.44	1.09
1977	0.49	1.14
1978	0.46	1.18
1979	0.52	1.32
1980	1.96	6.01
1981	1.56	3.01
1982	1.75	4.19
1971-1979	0.56	1.59
1977-1979	0.50	1.31
1980-1982	1.80	4.76

Table 13.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE
TEN-YEAR TREASURY BOND YIELD, IN BASIS POINTS

Fiscal Year(s)	Frequency		
	Daily	Weekly	Monthly
1971	2.37	15.1	32.0
1972	2.37	5.9	14.2
1973	2.88	6.9	17.5
1974	2.82	6.8	18.3
1975	5.48	11.4	25.5
1976	3.59	7.9	16.0
1977	4.14	8.3	19.9
1978	2.84	6.4	12.7
1979	4.37	7.8	16.0
1980	16.17	32.8	86.3
1981	16.32	28.6	46.1
1982	15.08	34.5	71.0
1971-1979	3.94	9.0	20.3
1977-1979	3.81	7.6	16.7
1980-1982	15.61	32.4	72.1

Table 14.

STANDARD DEVIATIONS OF FIRST DIFFERENCES OF THE NATURAL LOG
OF TEN-YEAR GOVERNMENT BOND YIELD
(Figures are Multiplied by 100)

<u>Fiscal Year(s)</u>	<u>Frequency</u>		
	<u>Daily</u>	<u>Weekly</u>	<u>Monthly</u>
1971	0.39	2.37	5.04
1972	0.39	0.98	2.30
1973	0.41	0.97	2.52
1974	0.38	0.92	2.54
1975	0.70	1.46	3.23
1976	0.46	1.00	2.04
1977	0.57	1.15	2.78
1978	0.35	0.79	1.56
1979	0.49	0.86	1.78
1980	1.43	2.90	7.77
1981	1.23	2.16	3.48
1982	1.09	2.46	5.08
1971-1979	0.54	1.26	2.85
1977-1979	0.47	0.95	2.14
1980-1982	1.23	2.55	5.86

Table 15.

RESULTS OF REGRESSION OF FIRST DIFFERENCES IN THE NATURAL LOG OF THE
THREE TO FOUR MONTH COMMERCIAL PAPER RATE ON FIRST DIFFERENCES
IN THE NATURAL LOG OF THE FEDERAL FUNDS RATE

Fiscal Year(s)	Frequency								
	Daily			Weekly			Monthly		
	$\hat{\beta}$	t	$\hat{\rho}$	$\hat{\beta}$	t	$\hat{\rho}$	$\hat{\beta}$	t	$\hat{\rho}$
1971*	.041	1.54	.140	.332	0.26	.055	.942	1.99	.815
1972	-.000	-.03	-.002	.078	1.28	.178	.628	4.17	.800
1973	-.008	-1.17	-.074	.035	0.88	.123	.476	2.44	.611
1974	.006	0.48	.031	.227	2.27	.306	1.048	7.25	.917
1975	-.014	-1.71	-.108	.098	1.03	.144	.959	4.80	.835
1976	.009	0.77	.049	.105	1.14	.158	1.024	5.89	.881
1977	-.001	-0.09	-.006	.213	2.02	.273	.891	10.28	.956
1978	.005	0.62	.039	.046	0.68	.096	.989	3.21	.712
1979	.008	0.90	.057	.156	1.43	.198	1.658	7.79	.926
1980	.087	4.33	.266	.367	4.57	.543	1.002	10.35	.956
1981	.148	6.75	.394	.302	3.83	.476	.773	5.38	.862
1982	.233	8.32	.474	.584	7.94	.744	1.061	7.18	.915
1971-1979	-.002	-0.61	-.013	.141	2.36	.112	.853	16.19	.853
1977-1979	.004	0.58	.022	.152	2.71	.213	1.064	10.75	.879
1980-1982	.128	9.59	.338	.400	8.73	.576	.946	14.21	.925

* Last 23 weeks only

Table 16.

RESULTS OF REGRESSION OF FIRST DIFFERENCES IN THE NATURAL LOG OF THE
THREE-MONTH TREASURY BILL YIELD ON FIRST DIFFERENCES IN THE
NATURAL LOG OF THE FEDERAL FUNDS RATE

Fiscal Year(s)	Frequency								
	Daily			Weekly			Monthly		
	$\hat{\beta}$	t	\hat{e}	$\hat{\beta}$	t	\hat{e}	$\hat{\beta}$	t	\hat{e}
1971	.013	1.14	.072	.069	1.10	.153	.892	4.01	.785
1972	-.004	-0.29	-.018	.133	1.32	.184	.726	3.93	.779
1973	.012	1.05	.067	.100	1.28	.176	.419	1.87	.509
1974	-.021	-0.87	-.056	.031	0.17	.024	.249	0.58	.180
1975	.015	1.10	.069	.142	1.34	.187	.783	5.29	.858
1976	.004	0.38	.024	.235	2.60	.345	.917	7.61	.923
1977	.032	1.74	.110	.266	2.54	.335	.825	4.66	.828
1978	-.022	-0.92	-.059	.214	1.56	.216	1.218	2.82	.666
1979	.016	0.72	.046	.104	0.56	.080	.881	2.88	.673
1980	.083	3.91	.242	.429	5.64	.624	.884	6.15	.889
1981	.066	2.55	.160	.274	3.70	.464	.594	3.96	.782
1982	.179	5.04	.311	.561	6.59	.678	1.103	5.44	.864
1971-1979	.007	1.42	.127	.113	3.61	.165	.714	10.37	.710
1977-1979	.012	0.98	.037	.176	2.12	.168	.883	6.61	.750
1980-1982	.093	6.16	.225	.414	9.10	.592	.846	9.56	.854

Table 17.

RESULTS OF REGRESSION OF FIRST DIFFERENCES IN THE NATURAL LOG OF THE
 ONE-YEAR BOND YIELD ON FIRST DIFFERENCES IN THE NATURAL LOG
 OF THE FEDERAL FUNDS RATE

Fiscal Year(s)	Frequency								
	Daily			Weekly			Monthly		
	$\hat{\beta}$	t	$\hat{\rho}$	$\hat{\beta}$	t	$\hat{\rho}$	$\hat{\beta}$	t	$\hat{\rho}$
1971	-.001	-0.11	-.007	.068	1.10	.153	1.012	5.48	.866
1972	-.001	-0.06	-.004	.099	1.32	.184	.442	2.70	.649
1973	.006	0.74	.047	.076	1.49	.204	.739	3.54	.746
1974	.003	0.19	.012	.211	1.85	.253	.618	2.34	.595
1975	.018	2.03	.128	.290	3.47	.440	.691	3.05	.694
1976	.013	1.10	.070	.361	3.93	.485	.983	4.70	.829
1977	.029	1.53	.097	.341	3.25	.414	.781	3.90	.777
1978	.001	0.07	.005	.218	2.28	.307	.910	3.70	.760
1979	.002	0.16	.010	.173	1.51	.208	1.311	5.47	.866
1980	.058	3.12	.195	.347	5.18	.591	.744	4.79	.834
1981	.060	2.68	.168	.202	3.59	.452	.294	2.04	.541
1982	.128	4.57	.285	.399	6.01	.644	.704	3.22	.713
1971-1979	.008	2.16	.046	.141	5.70	.255	.699	11.25	.738
1977-1979	.010	1.07	.040	.242	3.89	.298	.906	7.56	.792
1980-1982	.066	5.21	.192	.318	8.51	.566	.621	6.61	.750

Table 20.

RESULTS OF REGRESSION OF FIRST DIFFERENCES IN THE NATURAL LOG OF
 MOODY'S AAA CORPORATE BOND YIELD ON FIRST DIFFERENCES
 IN THE NATURAL LOG OF THE FEDERAL FUNDS RATE

Fiscal Year(s)	Frequency					
	Weekly			Monthly		
	$\hat{\beta}$	t	\hat{e}	$\hat{\beta}$	t	\hat{e}
1971	.011	0.78	.110	.210	3.91	.777
1972	-.003	-0.32	.045	.015	0.61	.187
1973	.008	0.82	.114	.063	1.05	.315
1974	.015	0.85	.118	.064	1.21	.358
1975	.000	0.02	.000	.055	0.82	.251
1976	.033	1.85	.253	.158	3.69	.759
1977	.028	0.96	.134	.124	2.13	.559
1978	.038	1.07	.148	.059	0.33	.105
1979	.075	2.30	.310	.253	2.02	.539
1980	.089	2.97	.387	.217	2.63	.639
1981	.059	2.25	.303	.012	0.16	.055
1982	.136	3.89	.482	.259	2.11	.555
1971-1979	.013	2.35	.110	.101	5.23	.453
1977-1979	.043	2.20	.173	.168	2.95	.451
1980-1982	.090	5.16	.383	.178	3.43	.507

Table 21

INTRAWEEK INTEREST RATE CYCLES, FISCAL YEARS 1978-1979:
 MEAN CHANGES BY DAY OF WEEK, IN BASIS POINTS
 (Standard Deviations in Parentheses)

<u>Interest Rate</u>	<u>Day of Week</u>				
	<u>Monday</u>	<u>Tuesday</u>	<u>Wednesday</u>	<u>Thursday</u>	<u>Friday</u>
Federal Funds	+8.41 (9.99)	-4.93 (13.67)	-11.76 (46.86)	+12.20 (35.75)	-0.08 (8.97)
3 to 4 Month Commercial Paper	+2.01 (4.30)	+1.10 (3.62)	+0.77 (5.62)	+0.37 (4.11)	+1.11 (4.26)
3-Month Treasury Bills	+0.24 (11.29)	+3.79 (10.35)	-1.82 (8.25)	-0.44 (7.18)	+2.10 (10.14)
1-Year Treasury Bonds	+0.76 (8.26)	-0.92 (5.63)	+0.11 (6.04)	+1.63 (5.49)	+1.67 (7.33)
5-Year Treasury Bonds	+1.18 (4.37)	+0.10 (4.51)	+0.10 (5.43)	+0.27 (3.67)	+0.48 (3.65)
10-Year Treasury Bonds	+0.95 (3.61)	-0.09 (3.30)	-0.07 (4.44)	+0.32 (3.43)	+0.51 (3.31)

Table 18.

RESULTS OF REGRESSION OF FIRST DIFFERENCES IN THE NATURAL LOG OF THE
 FIVE-YEAR TREASURY BOND YIELD ON FIRST DIFFERENCES IN THE
 NATURAL LOG OF THE FEDERAL FUNDS RATE

Fiscal Year(s)	Frequency								
	Daily			Weekly			Monthly		
	$\hat{\beta}$	t	$\hat{\rho}$	$\hat{\beta}$	t	$\hat{\rho}$	$\hat{\beta}$	t	$\hat{\rho}$
1971	.005	0.68	.043	.048	1.05	.147	.551	3.06	.695
1972	.005	1.00	.063	.057	1.60	.221	.171	2.00	.535
1973	.011	1.77	.112	.036	0.91	.126	.514	3.12	.702
1974	.004	0.45	.028	.111	1.71	.235	.387	2.95	.682
1975	.004	0.69	.044	.106	2.04	.277	.227	1.43	.412
1976	.014	2.17	.137	.126	2.53	.336	.377	4.11	.793
1977	.030	1.92	.121	.168	1.62	.222	.413	1.92	.518
1978	.006	0.63	.040	.139	2.13	.288	.281	1.14	.339
1979	-.009	-0.89	-.057	.115	1.71	.235	.438	2.29	.587
1980	.038	2.81	.176	.214	4.03	.496	.415	3.11	.701
1981	.036	2.19	.138	.111	2.69	.356	.049	0.54	.169
1982	.068	3.67	.232	.213	4.29	.515	.259	2.11	.555
1971-1979	.007	2.80	.059	.069	4.28	.194	.325	7.09	.567
1977-1979	.006	0.79	.030	.139	2.85	.223	.424	3.63	.529
1980-1982	.036	4.06	.151	.185	6.50	.464	.317	4.21	.585

Table 19.

RESULTS OF REGRESSION OF FIRST DIFFERENCES IN THE NATURAL LOG OF THE
TEN-YEAR TREASURY BOND YIELD ON FIRST DIFFERENCES IN THE
NATURAL LOG OF THE FEDERAL FUNDS RATE

Fiscal Year(s)	Frequency								
	Daily			Weekly			Monthly		
	$\hat{\beta}$	t	$\hat{\rho}$	$\hat{\beta}$	t	$\hat{\rho}$	$\hat{\beta}$	t	$\hat{\rho}$
1971	.003	0.56	.036	.014	0.40	.056	.349	2.86	.671
1972	.003	0.94	.060	.010	0.38	.054	.014	0.19	.059
1973	.003	0.89	.057	.009	0.42	.059	.252	2.23	.577
1974	.004	1.04	.066	.025	0.75	.105	.181	1.73	.481
1975	.004	0.83	.052	.067	1.65	.227	.080	0.68	.209
1976	.010	2.13	.135	.096	2.39	.320	.274	3.14	.075
1977	.012	1.14	.072	.100	1.51	.206	.249	1.63	.458
1978	.005	0.59	.038	.093	1.59	.220	.148	0.62	.194
1979	-.001	-0.14	-.009	.045	0.80	.113	.355	2.13	.559
1980	.034	2.79	.175	.157	3.81	.474	.267	2.43	.609
1981	.027	1.90	.120	.084	2.35	.315	.025	0.30	.093
1982	.054	3.25	.206	.192	4.00	.489	.286	1.85	.505
1971-1979	.004	2.51	.053	.029	2.47	.113	.168	4.79	.422
1977-1979	.002	0.45	.017	.076	2.14	.170	.283	3.06	.465
1980-1982	.031	3.94	.146	.146	6.03	.437	.216	3.36	.500

Table 22

INTRAWEEK INTEREST RATE CYCLES, FISCAL YEARS 1980-1981:
 MEAN CHANGES BY DAY OF WEEK, IN BASIS POINTS
 (Standard Deviations in Parentheses)

<u>Interest Rate</u>	<u>Day of Week</u>				
	<u>Monday</u>	<u>Tuesday</u>	<u>Wednesday</u>	<u>Thursday</u>	<u>Friday</u>
Federal Funds	+7.04 (70.8)	-21.88 (72.1)	-39.78 (118.6)	+61.17 (91.5)	-2.34 (55.8)
3 to 4 Month Commercial Paper	+1.38 (30.7)	+2.06 (32.3)	-7.06 (27.4)	+0.10 (28.9)	+8.09 (29.1)
3-Month Treasury Bills	+0.91 (41.8)	+0.68 (24.7)	-2.84 (21.7)	-0.37 (24.3)	-2.21 (31.1)
1-Year Treasury Bonds	+5.08 (35.7)	-0.23 (20.5)	+1.40 (21.2)	+4.84 (20.1)	-4.25 (29.9)
5-Year Treasury Bonds	+5.12 (22.9)	+1.04 (17.1)	+2.54 (13.9)	+2.33 (15.1)	-3.43 (19.6)
10-Year Treasury Bonds	+5.09 (17.8)	+0.66 (14.6)	+1.54 (13.0)	+2.88 (15.0)	-3.25 (17.2)

Table 23

INTRAWEEK INTEREST RATE CYCLES, FISCAL YEAR 1980:
 MEAN CHANGES BY DAY OF WEEK, IN BASIS POINTS
 (Standard Deviations in Parentheses)

<u>Interest Rate</u>	<u>Day of Week</u>				
	<u>Monday</u>	<u>Tuesday</u>	<u>Wednesday</u>	<u>Thursday</u>	<u>Friday</u>
Federal Funds	+7.02 (70.0)	-47.84 (52.5)	-56.3 (108.5)	+72.2 (95.0)	+13.30 (47.1)
3 to 4 Month Commercial Paper	+5.71 (2.59)	-1.14 (22.8)	-7.54 (28.7)	-8.31 (26.9)	+10.41 (24.2)
3-Month Treasury Bills	+5.51 (34.3)	-0.07 (25.0)	-8.48 (17.7)	+0.22 (24.4)	+1.39 (26.0)
1-Year Treasury Bonds	+3.38 (27.8)	-4.77 (18.3)	-2.48 (19.3)	+6.18 (21.0)	-0.02 (29.5)
5-Year Treasury Bonds	+5.82 (19.3)	-2.67 (16.2)	+0.77 (14.3)	+2.37 (16.1)	-1.41 (18.6)
10-Year Treasury Bonds	+5.44 (15.1)	-2.42 (14.1)	-0.58 (14.8)	+3.49 (15.6)	-1.94 (16.0)

Table 24

INTRAWEEK INTEREST RATE CYCLES, FISCAL YEAR 1981:
 MEAN CHANGES BY DAY OF WEEK, IN BASIS POINTS
 (Standard Deviations in Parentheses)

<u>Interest Rate</u>	<u>Day of Week</u>				
	<u>Monday</u>	<u>Tuesday</u>	<u>Wednesday</u>	<u>Thursday</u>	<u>Friday</u>
Federal Funds	+7.06 (72.3)	+2.46 (79.7)	-23.92 (126.5)	+49.71 (87.2)	-18.31 (59.8)
3 to 4 Month Commercial Paper	-2.77 (34.6)	+4.98 (39.1)	-6.61 (26.4)	+9.04 (28.4)	+5.63 (33.7)
3-Month Treasury Bills	+12.51 (48.0)	+1.36 (24.7)	+2.47 (23.9)	-1.00 (25.2)	-6.04 (35.6)
1-Year Treasury Bonds	+6.70 (42.1)	+3.91 (21.7)	+5.06 (22.5)	+3.44 (19.1)	-8.76 (30.1)
5-Year Treasury Bonds	+4.45 (26.1)	+4.45 (17.3)	+4.20 (13.5)	+2.29 (14.1)	-5.59 (20.5)
10-Year Treasury Bonds	+4.74 (20.3)	+3.47 (14.7)	+3.53 (10.9)	+2.23 (14.4)	-4.65 (18.5)

Table 25

INTRAWEEK INTEREST RATE CYCLES, FISCAL YEAR 1982:
 MEAN CHANGES BY DAY OF WEEK, IN BASIS POINTS
 (Standard Deviations in Parentheses)

<u>Interest Rate</u>	<u>Day of Week</u>				
	<u>Monday</u>	<u>Tuesday</u>	<u>Wednesday</u>	<u>Thursday</u>	<u>Friday</u>
Federal Funds	+0.67 (55.2)	-2.40 (45.2)	+10.42 (67.8)	+0.46 (61.3)	-22.94 (38.3)
3 to 4 Month Commercial Paper	-7.00 (38.3)	+0.54 (20.8)	-5.46 (22.3)	2.27 (17.2)	-0.94 (23.2)
3-Month Treasury Bills	-0.27 (36.6)	+0.24 (21.4)	-4.50 (16.9)	-8.61 (24.4)	-2.17 (25.5)
1-Year Treasury Bonds	1.30 (34.3)	-3.26 (18.6)	1.24 (15.8)	-6.49 (21.3)	-6.63 (27.1)
5-Year Treasury Bonds	2.41 (23.1)	-2.43 (15.4)	2.32 (10.0)	-4.61 (14.7)	-6.56 (17.3)
10-Year Treasury Bonds	2.52 (20.7)	-1.74 (13.2)	2.22 (10.4)	-4.82 (12.9)	-5.52 (15.7)

Table 26

F-STATISTICS FOR DAY-OF-WEEK EFFECTS ON
 FIRST DIFFERENCES OF INTEREST RATES
 (Degrees of Freedom in Denominator Shown in Parentheses)

Fiscal Years	Interest Rate					
	Federal Funds	3 to 4 Month Commercial Paper	3-Month Treasury Bill	1-Year Bond	5-Year Bond	10-Year Bond
1978-1979	11.99*** (487)	7.99*** (466)	5.14*** (466)	2.52** (466)	0.94 (466)	1.28 (466)
1980-1981	20.20*** (484)	3.23** (470)	2.52** (470)	2.08* (470)	2.89** (470)	3.67*** (470)
1980	21.55*** (242)	4.80*** (229)	1.82 (231)	1.78 (231)	1.74 (231)	2.44** (231)
1981	5.33*** (242)	1.94 (234)	2.02* (234)	2.26* (234)	2.42** (234)	2.55** (234)
1982	2.53** (241)	1.19 (236)	0.98 (234)	1.27 (234)	2.90** (234)	3.12** (234)

* Significant at the .1 level
 ** Significant at the .05 level
 ***Significant at the .01 level

Table 27

PROPORTION OF TOTAL VARIATION IN FIRST DIFFERENCES OF INTEREST RATES
EXPLAINED BY DAY-OF-WEEK EFFECTS, AS MEASURED BY SQUARE ROOT OF R²

Fiscal Years	Interest Rate					
	Federal Funds	3 to 4 Month Commercial Paper	3-Month Treasury Bill	1-Year Bonds	5-Year Bonds	10-Year Bonds
1978-1979	.299	.253	.206	.146	.090	.104
1980-1981	.378	.164	.145	.132	.155	.174
1980	.517	.277	.175	.173	.171	.201
1981	.285	.179	.183	.193	.201	.204
1982	.201	.141	.128	.146	.217	.225

Table 28

STANDARD DEVIATION OF DAY-OF-WEEK
MEANS, IN BASIS POINTS

Fiscal Years	Interest Rate					
	Federal Funds	3 to 4 Month Commercial Paper	3-Month Treasury Bill	1-Year Bonds	5-Year Bonds	10-Year Bonds
1978-1979	9.7	0.61	2.2	1.09	0.45	0.43
1980-1981	38.3	5.4	1.7	3.9	3.1	3.1
1980	52.1	8.2	5.1	4.4	3.3	3.5
1981	29.1	6.5	6.8	6.2	4.3	3.7
1982	12.3	4.0	3.6	3.9	4.1	3.8

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