

Determinants of U.S. Treasury Bill Rates

Real interest rates (nominal rates less expected inflation) in the United States, especially those on short-term securities, rose sharply in the 1980s to heights far above their levels in the previous three decades. Moreover, the episode of high real Treasury bill rates in the early 1980s was not peculiar to the United States, but was widespread across OECD countries (ATKINSON and CHOURAQUI, 1985). Such a positive association of real interest rates across countries could be due to either the impacts of worldwide shocks (such as oil price changes) or the transmission of domestic shocks to foreign countries through international linkages of financial markets. In any case, because the United States is far and away the largest OECD country, a rise in U.S. rates likely drove other OECD rates rather than the reverse. Thus, the determination of U.S. interest rates is of importance to investors outside the United States, as well as those within [1].

While the height of the real rates in the early 1980s is indisputable, the cause is widely debated. Shifts in monetary policy and government saving are often cited, and changes in private saving and investment are also mentioned. A restrictive U.S. monetary policy and a decline in private world saving are identified in this paper as the major sources of the high real rates.

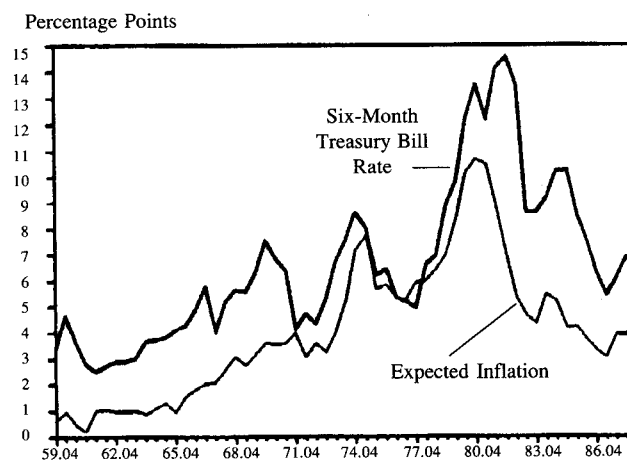
Before analyzing the 1980s in detail, we consider determinants of real rates in the more normal 1960s and 1970s. This earlier period is particularly relevant because the unusually high real bill rates in the early 1980s appear to have been a temporary aberration; real bill rates returned to normal levels in

early 1986, and since then seem to be behaving as they did in the earlier decades. After examining the 1980s, we speculate briefly about future real bill rates. At all times, the expected real rate on six-month U.S. Treasury bills is the variable analyzed.

The Bill Rate and Its Determinants in the 1960s and 1970s

The nominal six-month Treasury bill rate and the six-month expected inflation rate are plotted at semiannual intervals in Figure 1 for the April 1959 to April 1988 period [2]. As can be seen, the nominal rate rose from about 3 percent in the early 1960s to around 13 percent in 1980, while the expected inflation rate rose from 1 to 10 percent. Since 1980, expected inflation has declined to 4 percent, and the bill rate has declined to 6 or 7 percent. The nominal

Figure 1: Nominal Bill Rate and Expected Inflation



bill rate is obviously related to expected inflation. Equally obvious, though, is that changes in the expected inflation rate are not the only source of movement in the nominal rate. Put another way, the expected real bill rate, the nominal rate less expected inflation, is not constant. For example, the real bill rate averaged only 0.2 percent from the middle of 1974 to the middle of 1978, whereas it averaged 5.2 percent from 1981 to 1985. For the entire April 1959 to April 1988 period, the average was 2.6 percent.

While much of the movement in the nominal bill rate is explained by changes in expected inflation, a strong cyclical element remains once this expected-inflation effect is removed. That is, the real bill rate moves systematically with the U.S. business cycle

Figure 2: Real Bill Rate and the Business Cycle

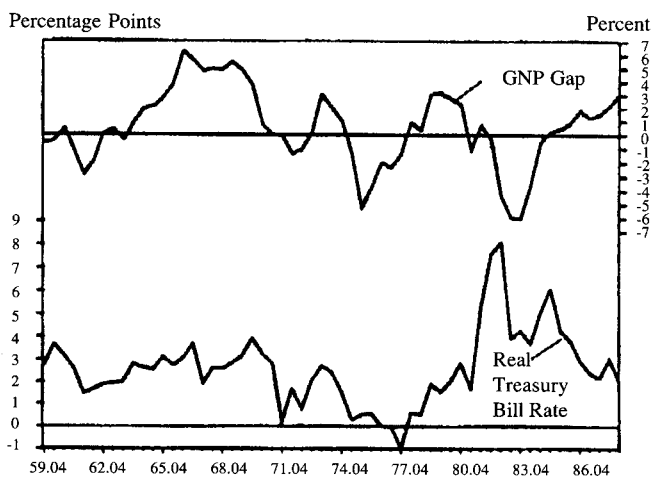
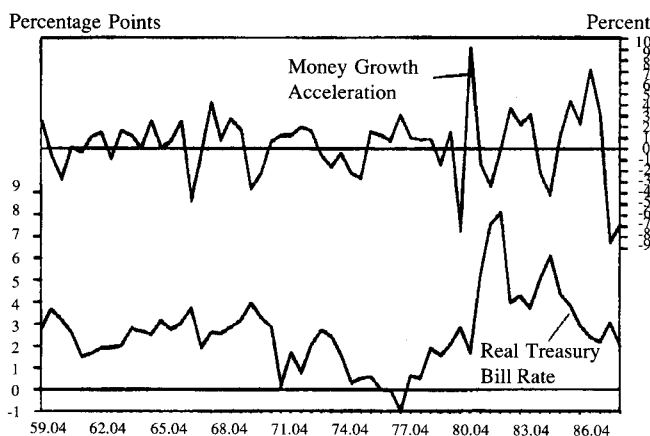


Figure 3: Real Bill Rate and the Acceleration in Money Growth



(or at least did prior to the 1980s). Our business cycle proxy is the gap between actual real GNP and middle-expansion trend real GNP calculated by the Bureau of Economic Analysis as a percentage of middle-expansion GNP. Figure 2 pictures the relationship between the real bill rate and the GAP variable. The positive correlation in the 1960s and 1970s is striking. Overall, the real bill rate rose by two to three percentage points from trough to peak over each business cycle.

Although the positive correlation reflects cyclical swings in private credit demands, it stems largely from the countercyclical nature of monetary policy: policy eases when the economy is sluggish and tightens as full employment is approached. A widely used proxy for monetary policy is the acceleration in the growth rate in narrowly defined money. Figure 3 contains such a measure, the growth rate of the M1 definition of money during the previous six months relative to its growth rate during the previous three years. For the 1960s and 1970s, this series appears to be a reasonable proxy for the stance of monetary policy, clearly indicating the credit crunches in 1966 and 1969 as well as the tight money episode in 1973-74. However, its behavior in the early 1980s is inconsistent with the general perception of sustained tight monetary policy, possibly because financial deregulation and innovation in these years distorted this measure of the money supply and hence its rate of growth (see, for example, SIMPSON, 1984). Consequently, an alternative, or additional, monetary policy proxy may be needed for the early 1980s.

The OPEC oil shocks have also received much attention as determinants of interest rates. Following the two sharp oil price increases in the 1970s, oil-export countries did not immediately purchase imports with their rapidly growing export receipts. This behavior led to a temporary surge in their current account surplus. Thus, the oil shocks resulted in a transfer of income to countries with (at least temporarily) high marginal propensities to save from countries with lower propensities, a transfer that increased private world saving and lowered real interest rates (SACHS, 1981) [3]. We

use the current account surplus of oil exporting countries from "International Financial Statistics" divided by middle-expansion GNP as our OPEC proxy.

The combination of the two cyclical variables, expected inflation, and the 1974 surge in OPEC saving explains most of the movement in the nominal bill rate in the 1960s and 1970s. The success of these variables is illustrated in Figure 4, which plots the observed nominal bill rate and the "fitted" bill rate. During the April 1959 - April 1979 period, the fitted bill rate is almost always within one percentage point of the observed rate.

In the 1980s, however, the forecast of the bill rate calculated from our 1959-79 relation fails to track the observed bill rate. While the observed rate rises somewhat above its 1980 level in 1982 before receding along an oscillating path to 1987, the calculated rate declines sharply during late 1980 and throughout 1981 and then mimics the movement (but not the level) of the observed rate until 1986 and 1987 when the real-bill-rate forecast appears to get back on track. Between late 1980 and the end of 1985, the observed bill rate continually exceeded the forecasted rate by over two percentage points, and the difference averaged over five percentage points from October 1980 to April 1982. This difference, which corresponds to the extraordinarily high real bill rates in the 1981-85 period, is the interest rate puzzle researchers have been striving to solve and is the topic addressed in the rest of this paper. We note, however, that the period of unusually high real interest rates has passed. By 1986 the real six-month bill rate was again within the "normal" 1959-79 range, and by 1987 the observed real bill rate was below the forecast.

High Real Interest Rates in the 1980s

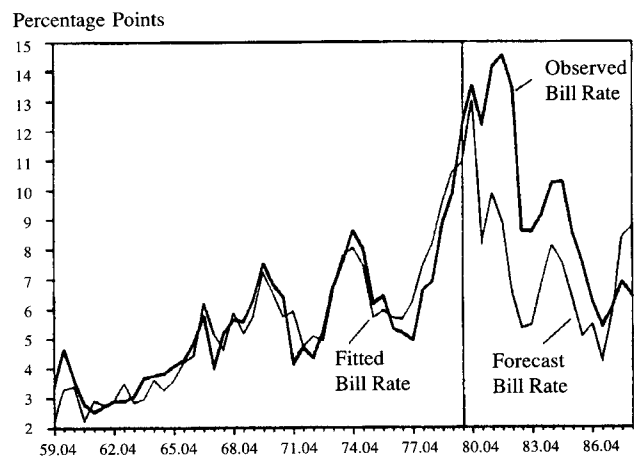
The extraordinarily high real bill rates in the 1980s (or at least in the 1980-84 period) have been attributed to numerous factors. The most commonly offered pieces to the puzzle are tight monetary policy and reduced public saving (primarily large

U.S. deficits). Both of these and reduced private world saving are discussed in turn.

Although the money-growth acceleration variable appears to explain much of the cycle in real bill rates prior to 1980, this variable explains virtually none of the six and a half percentage point jump in real bill rates in late 1980 and 1981. That the U.S. Federal Reserve played no role in the jump is implausible; the Federal Reserve was committed to, and indeed did succeed in, lowering the inflation rate in this period. However, as previously noted, monetary growth rates were likely distorted when deposit interest rate ceilings were being deregulated and new deposit accounts were being created. As a supplement to our acceleration variable, we develop a second proxy for monetary policy based on the behavior of the six-month U.S. bill rate, which the Federal Reserve can control over short periods, and the 10-year U.S. Treasury bond rate, over which the Federal Reserve has decidedly less control.

The slope of the term structure of interest rates (the ratio of the six-month and ten-year rates) would be expected to flatten (our ratio would rise) when monetary policy tightens, other things being equal. Of course, other things do not remain equal; factors other than monetary policy affect the term structure. When short-term expected inflation rises relative to long-term inflation, when a business cycle boom is in progress, and when monetary growth

Figure 4: The Nominal Treasury Bill Rate: Observed and Fitted/Forecast



decelerates, the short rate tends to be high relative to the long rate. In fact, the term structure became inverted (the rate ratio exceeded unity) on five

Figure 5: Observed and Fitted/Forecast of the Short/Long Treasury Rate Ratio

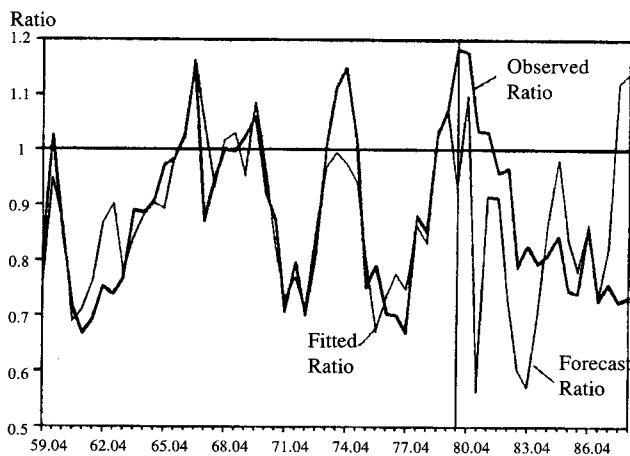
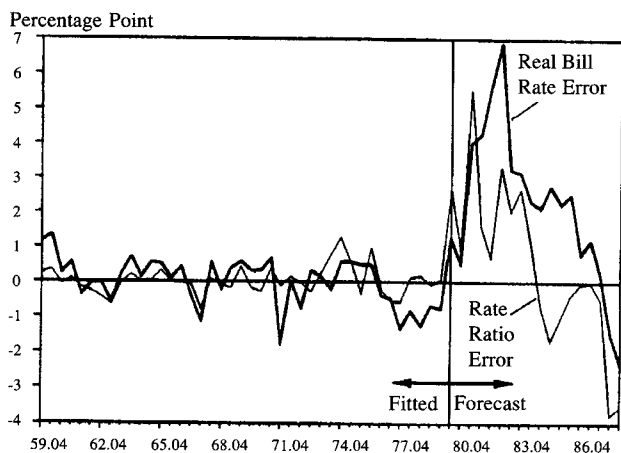


Figure 6: Bill Rate and Rate Ratio Fitted/Forecast Errors



occasions since 1959.

Over 75 percent of the 1959-79 variation in the ratio of short to long rates is explained by the ratio of the Livingston expected inflation rates for eight and fourteen months, our GAP variable, and the monetary growth acceleration variable. The observed and fitted ratios for this period, as well as the forecasted values for the 1980-87 period, are shown in Figure 5. The relationship between the rate ratio and the posited explanatory variables breaks down during the 1980-83 period, with the rate ratio jumping relative to the other variables, suggesting that

monetary policy may have indeed been far tighter than the monetary growth acceleration variable alone implied.

To isolate the monetary policy component of the fluctuations in the short/long rate ratio (not already accounted for by the monetary growth acceleration variable), the impact of the other determinants must be removed. Figure 6 plots the residual of the estimated short/long rate ratio relation (not already accounted for by the monetary growth acceleration variable) and its forecast error for the 1980s (multiplied by the ten-year bond rate to convert the forecast error to the same units as the six-month bill rate) against the residual of our 1959-79 bill rate equation and its forecast error. The rate-ratio residual "explains" over half of our bill rate error in the 1980-83 period. That is, this piece of the interest rate puzzle is a high real bill rate, not high real interest rates generally, and is probably attributable to an extraordinarily tight U.S. monetary policy.

The second proposed piece of the puzzle is budget deficits, specifically the decline in government saving, particularly in the United States (FELDSTEIN, 1985). The expected structural, or cyclically-adjusted, deficit as a percentage of middle-expansion GNP is the proper deficit measure, and the expectation should be over the life of the debt instrument. Given that we are examining six-month bill rates, the average structural deficit in the current and next quarter is relevant. This deficit, a comparable deficit for the other six major OECD countries (availa-

Figure 7: Bill Rate Error and Structural Budget Deficits as a Percent of GNP/GDP

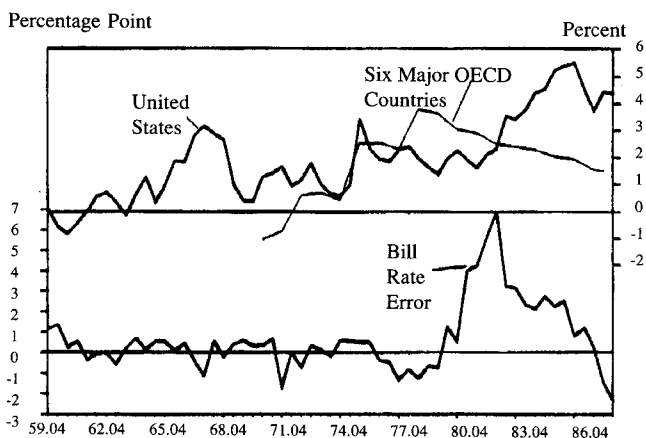
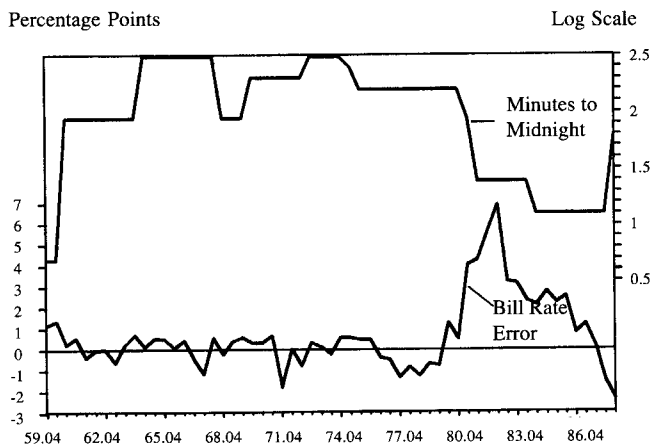


Figure 8: Bill Rate Error and Minutes to Midnight

ble for the 1970-87 period only), and the residuals (1959-79) and forecast errors (1980-87) of our basic 1959-79 relationship are plotted in Figure 7. The deficit pieces do not seem to fit the interest rate puzzle. The U.S. structural deficit did not rise in 1980-81, when the large error in the forecast developed, and did not decline in the 1982-85 period, when the error and the real bill rate were falling. That is, the deficit shifts were precisely opposite to those required to explain the real-rate movements. The OECD deficit does little better; it moved inversely with the real bill rate in the 1976-81 period, again contrary to the behavior needed to explain the real rate [4].

While shifts in government saving explain little of the puzzle, what about private world saving? As noted earlier, this saving was stimulated in both 1974-77 and 1979-80 by the two oil shocks, and thus the absence of shocks in the 1981-85 period, when real interest rates were so high, would have decreased private saving relative to earlier years. SLEMROD (1986) has suggested another cause of reduced private saving: heightened fear of nuclear war. If war is considered imminent, saving makes little sense.

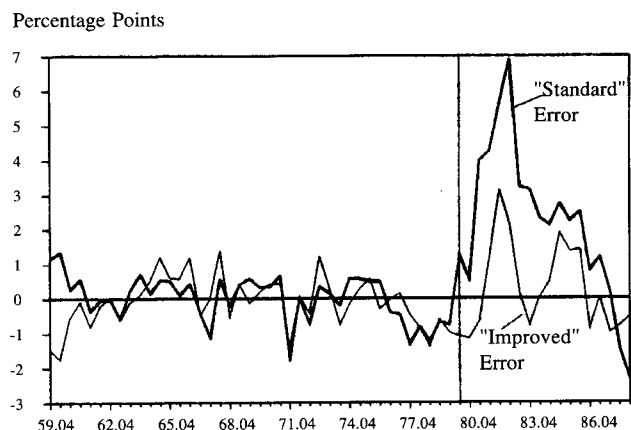
Slemrod's proxy for fear of nuclear war is the minutes-to-midnight series published by the "Bulletin in the Atomic Scientists". With midnight being war, the fewer are the minutes, the closer is war, the lower is the incentive to save, and thus the higher would real interest rates be. The natural logarithm of minutes to midnight and the residuals and fore-

cast errors of our 1959-79 real-bill-rate equation are plotted in Figure 8. Minutes-to-midnight fell dramatically in the early 1980s with the election of Ronald Reagan and his "evil-empire" speeches, precisely when the real interest rate jumped to unprecedented heights. Thus, a decline in private saving, due both to the absence of oil shocks and heightened fear of nuclear war, is the second piece we offer to solve the interest-rate puzzle.

The inclusion of the two additional explanatory variables, the residual from the rate ratio equation (multiplied by the 10-year Treasury bond rate) and the logarithm of minutes to midnight, dramatically improves our ability to explain the high real rates in the 1980s. Figure 9 contains the fitted/forecast error from the original equation and the fitted error from the "improved" equation. The error from the improved equation is a third that from the original specification for the October 1980 to October 1985 period of unusually high real interest rates. Moreover, the forecast is no longer below actual real bill rates after 1985 [5].

Summary and Look to the Future

The results of our investigation of the U.S. six-month Treasury bill rate are summarized by the data in Table 1. The 1959-86 period has been divided into five real bill rate cycles. The first column gives the actual change in the real bill rate during the

Figure 9: Bill Rate Fit/Forecast Errors

different subperiods, while the remaining columns attribute the change to shifts in monetary policy, economic activity, private saving (nuclear fear and oil shocks), and unidentified factors. Our discussion of the period is usefully partitioned into two parts: 1959-79 and 1980-86.

Over the typical business cycle in the 1960s and 1970s, the real bill rate rose and then fell by 2 to 3 percentage points (column 1) [6]. Over three-quarters of these movements are explained within our framework. With one exception (the first decline in the table, which is largely attributable to a decline in the fear of nuclear war), the primary cause of real bill rate cycles is monetary policy. Again with one exception (the sharp shifts in monetary policy during the 1966-69 period when only a minor business cycle occurred), monetary policy shifts reinforce swings in the real rate caused by the business cycle (note the correlation of the numbers in columns 2 and 3).

The October 1979 - April 1986 period is an altogether different story. The changes in real interest rates were twice as large as in the previous two decades, and the real rate moved perversely, rising during the 1980-82 economic downturn and falling during the 1983-86 upswing (the changes in columns 1 and 3 are negatively related). However, the largest contributing factor to the real rate move-

ments continued to be monetary policy shifts, although lower private saving (heightened fear of nuclear war and deterioration in OPEC's current account) raised real rates generally. Also, over half of the 6 percentage point rise and fall in real rates is not explained.

The future seems more likely to resemble the 1960s and 1970s than the 1980-85 period. That is, the real bill rate should revert to fluctuating by two or three percentage points over the business cycle, rising in upswings and declining in recessions. The 1980-85 period was an aberration triggered largely by a need to wring-out the inflation built up in the late 1970s. A pure cyclical rise in inflation would likely raise real rates because monetary policy would tighten, but the continuation, or even magnification, of tight money during a subsequent slowdown seems unlikely.

Real interest rates were generally low in the mid to late 1970s and high in the first half of the 1980s; real rates averaged 4-1/4 percentage points more in the 1981-85 period than in 74-80. Just over 3 percentage points of this difference can be attributed to shifts in private world saving. This saving rose in the first period because the sharp rise in oil prices redistributed income to higher-saving OPEC countries and fell in the second period because oil prices decreased and the fear of nuclear holocaust increased.

Table 1: Cyclical Changes in The Real Bill Rate and Estimates of Their Causes

	(1)	(2)	(3)	(4)	(5)
		Source of Change: Shifts in			
	Actual Change	Monetary Policy	Economic Activity	Private Saving	Unidentified Factors
Oct. 1959 - April 1961	- 2.18	- 0.61	- 0.35	- 2.16	0.95
April 1961 - Oct. 1966	2.22	1.61	1.21	- 0.93	0.33
Oct. 1966 - April 1967	- 1.83	- 2.20	- 0.11	0.00	0.49
April 1967 - Oct. 1969	2.05	1.71	- 0.16	0.31	0.18
Oct. 1969 - April 1972	- 3.18	- 1.77	- 0.67	- 0.13	- 0.60
April 1972 - April 1973	1.96	1.14	0.58	- 0.44	0.68
April 1973 - April 1977	- 3.72	- 2.05	- 0.63	- 0.33	- 0.71
April 1977 - Oct. 1979	3.04	3.68	0.58	0.59	- 0.63
Oct. 1979 - April 1982	6.05	1.20	- 1.00	2.62	3.22
April 1982 - April 1986	- 5.14	- 4.10	0.88	1.12	- 3.03

Future oil price shocks are likely to be smaller than earlier ones and to have even less impact because the differences in saving rates across the OPEC and industrialized countries have narrowed. On the other hand, the thaw in Soviet-U.S. relations is certain to reduce the fear of nuclear war (minutes to midnight doubled in January 1988 from 3 to 6). Continued warmth in this relationship should contribute to greater private world saving and lower real interest rates generally.

Footnotes

- [1] The determination is, of course, especially important to investors who hold U.S. debt instruments. Foreigners held as much as 25 percent of U.S. Treasury securities in the late 1970s, and this percentage is still close to 20 percent in spite of the recent explosion in these issues. In early 1988, nonresidents held \$325 billion of U.S. Treasury securities alone.
- [2] The Treasury bill rate has been converted from a discount basis to a bond-equivalent yield. The expected inflation rate series is from the Livingston survey data. We use April and October monthly averages of the interest rate to correspond to the timing of the semiannual Livingston data.
- [3] Two other aspects of the OPEC shocks have also been emphasized. First, the increase in the relative price of oil has been hypothesized to decrease investment. Second, a portfolio effect further reducing short-term interest rates would be present if OPEC's preference for interest-bearing short-term financial assets is greater than that of the residents in the countries from which income (and wealth) is being transferred (see, for example, PEEK and WILCOX, 1983).
- [4] We also considered a weighted average money growth acceleration variable for the same six countries. However, it did not contribute to the explanation of the U.S. real bill rate.
- [5] When we estimated the "improved" specification through April 1979 and forecast the 1980s, the errors were much smaller than those from the "standard" specification. For the October 1980 to October 1985 period, the forecast errors averaged (in absolute value) only 60 percent of those from the standard forecast. Moreover, the errors for April 1986 through April 1988 averaged only 30 basis points, indicating the forecast was right on track after 1985.
- [6] The cyclical fluctuations in real rates can generally be traced to unexpected changes in inflation and real economic activity (HENDERSHOTT, 1984).

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