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THE TIME SERIES BEHAVIOR OF REAL INTEREST RATES
A COMMENT

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I. INTRODUCTION

The Huizinga and Mishkin [1985] paper presents a strong case that the changes in monetary policy "regimes" by the Federal Reserve Board in October, 1979 and in October, 1982 caused major changes in the behavior of real interest rates. Through a variety of statistical tests that are designed to detect changes in the parameters of a stochastic process, Huizinga and Mishkin show that real interest rates have behaved differently after October, 1979 than before. Of course, that is the month when the Fed first announced a new policy of focusing primarily on money supply targets rather than nominal interest rate targets. Huizinga and Mishkin find a less pronounced change in the behavior of real rates after October, 1982, when the Fed announced that it was abandoning sole reliance on money supply targets. To corroborate their impressions of the recent behavior of real interest rates, Huizinga and Mishkin study the period following World War I when the Fed increased the discount rate by large amounts, and they find a change in the behavior of real rates at that time.

The results in the Huizinga/Mishkin paper are thought-provoking because they seem too good to be true. The statistical techniques used are not powerful enough to detect small parameter changes in moderate sample sizes, so their findings indicate relatively large changes in the time series behavior of real interest rates that are coincident with the changes in regimes. In the rest of this paper I will play the role of Devil's advocate, attempting to qualify or raise questions about the interpretation of the Huizinga/Mishkin results, but it seems clear that even a skeptic

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must conclude that the facts they have discovered deserve further analysis.

II. ALTERNATIVE STOCHASTIC PROCESSES FOR EX POST REAL RATES OF INTEREST

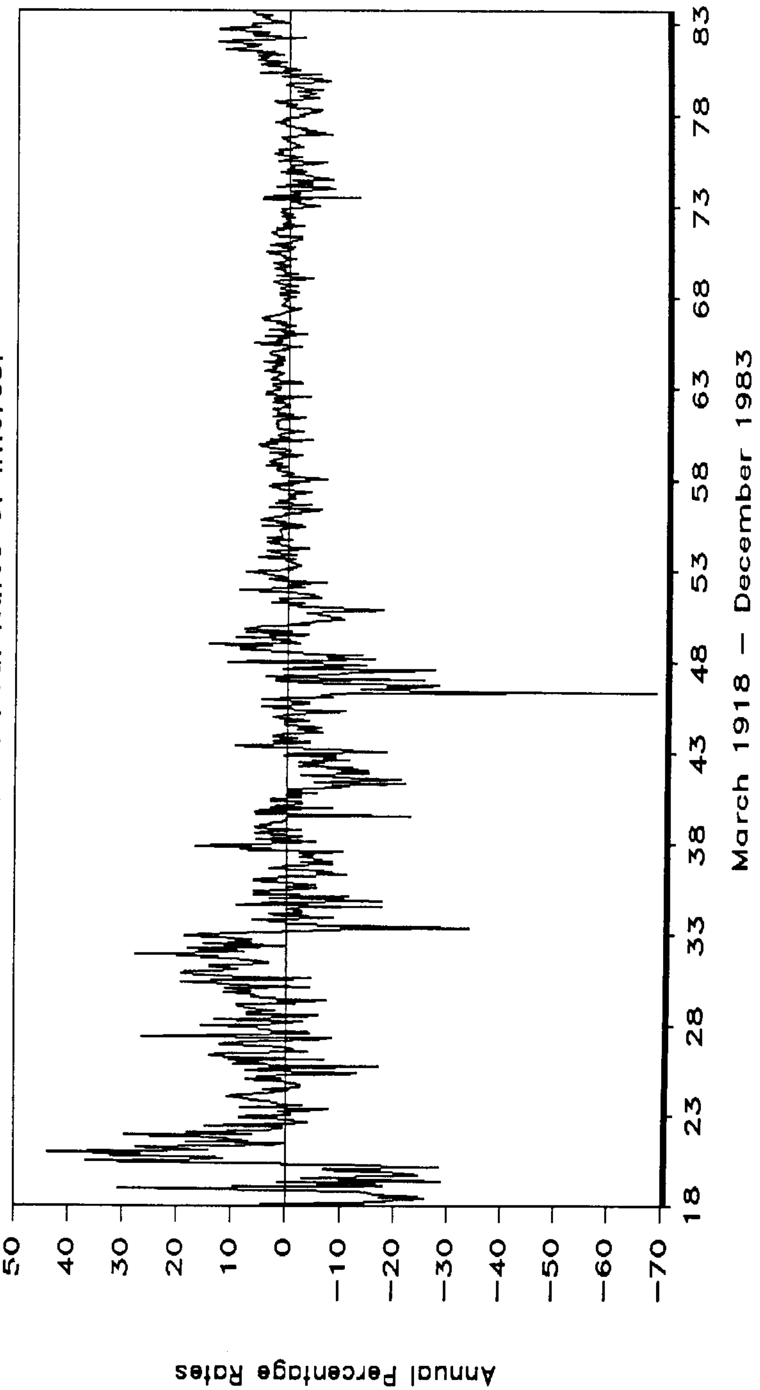
To study whether monetary policy regime shifts affects the behavior of (ex post) real interest rates, it is first necessary to specify the stochastic process for real rates. Huizinga and Mishkin consider regression models for the real rate as a function of (a) lagged (C.P.I.) inflation rates, π_t, (b) the current nominal interest rate, i_t, and (c) a "supply shock" variable, the lagged change in the relative price of energy (see Wilcox [1983]). Interestingly, they do not use variables such as the growth rate of the money supply or the Federal Reserve discount rate as direct measures of the influence of monetary policy on real rates (although the discussion in footnote 16 indicates they believe that such variables would not improve the predictive power of their models).

Since the current nominal interest rate is a predetermined variable, the problem of forecasting the real rate of interest is identical to the problem of forecasting the inflation rate. The Huizinga/Mishkin model for the real rate is equivalent to a regression of the current inflation rate on the current nominal interest rate, the lagged supply shock variable, and two lags of inflation (subtracting the nominal rate from both sides of the real rate regression). I have studied the behavior of the C.P.I. inflation rate in the United States and its relation to nominal and real interest rates (see, for example, Nelson and Schwert [1977]), and I was curious as to whether alternative specifications of the stochastic process for real rates would alter the conclusions reached by Huizinga and Mishkin. Accordingly, I analyzed data similar to that studied by Huizinga and Mishkin, except that I did not use their supply shock variable.

Data for one-month interest rates come from Ibbotson [1984] between 1926-83, and between 1918-26 I use one-month brokers' time loan rates, adjusted so that the average of these rates equals the average of the Treasury Bill rates during 1926. The monthly inflation rate is calculated from the Consumer Price Index (CPI-U). All variables are continuously compounded. Figure 1 contains a plot of the ex post real rates of interest (the difference between the nominal rate and the inflation rate) expressed as annual percentage rates from 1918-83. It is apparent from this graph that the volatility of real rates has increased in recent years relative to

Figure 1

Ex Post Real Rates of Interest



the post-1953 experience. However, the pre-1953 behavior of real rates is much more volatile than in the post-1979 period.

Figure 2 contains forecasts of the annual percentage real rate of interest based on an average of the last 12 monthly real rates. This crude model is suggested by Fama and Gibbons [1984] as a relatively good method of forecasting inflation (or real rates of interest). This plot shows that predicted real rates were relatively stable from 1953-70, generally negative during the 1970s, and they rose dramatically around 1979. Again, however, the behavior of the predicted real rate is much more variable before 1953 than in the post-1979 period. In particular, the predicted real rates were negative from 1919-20 and then rose dramatically during 1920. This is the period studied by Huizinga and Mishkin when the Federal Reserve raised its discount rate. Of course, there are many other changes in the predicted real rate series that are not studied by Huizinga and Mishkin. The drop in real rates in mid-1946 is due to the release of World War II price controls which artificially raised the CPI inflation rate and lowered the measured real rate. Nevertheless, there is substantial variation in the predicted real rate series that is not explained by data errors, nor by apparent changes in monetary policy.

To provide a further check on the Huizinga/Mishkin results, I estimate a model for the inflation rate as a function of the current nominal interest rate with a first-order moving average (MA(1)) process for the errors,

$$(\pi_t - \pi_{t-1}) = \alpha + \beta(i_t - i_{t-1}) + (1-\theta L)\varepsilon_t, \tag{1}$$

where $(\pi_t - \pi_{t-1})$ is the change in the monthly inflation rate, $(i_t - i_{t-1})$ is the change in the nominal interest rate, θ is the moving average parameter, and L is the lag operator (i.e., $L^k X_t = X_{t-k}$). This is the same model used by Nelson and Schwert [1977] to forecast inflation as a function of interest rates and lagged inflation. It differs from the Huizinga/Mishkin model,

$$\pi_t = \alpha + \beta i_t + \gamma_2 \pi_{t-1} + \gamma_2 \pi_{t-2} + \varepsilon_t, \tag{2}$$

because an exponentially weighted average of all past inflation rates is used in (1), whereas only the last two inflation rates are used in (2). Nevertheless, the information set for these two models is the same.

Table 1 contains estimates of the Nelson/Schwert model in (1) and the

Figure 2

Predicted Real Rates of Interest

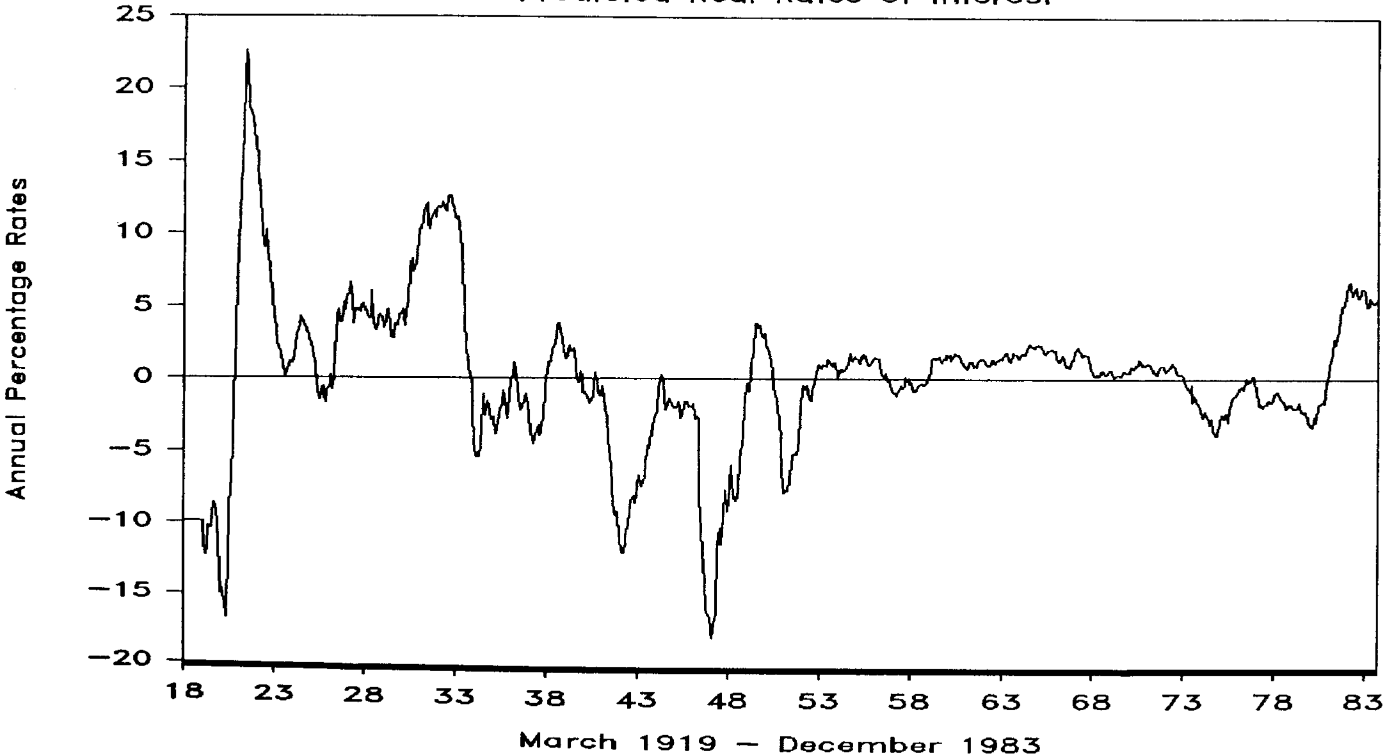


Table 1

Alternative Models for the C.P.I. Inflation Rate
(Standard Errors in Parentheses)

A. Nelson-Schwert

$$(\pi_t - \pi_{t-1}) = \alpha + \beta(i_t - i_{t-1}) + (1-\theta L)\varepsilon_t \qquad (1)$$

Sample Period	α	β	θ	$S(\varepsilon)$	F-Test for Stability (Degrees of Freedom)
4/18 - 5/20	.001	-1.89	.542	.0125	
	(.001)	(11.4)	(.177)		
					0.63
					(3,111)
4/18 - 12/27	.000	.077	.531	.0094	
	(.0004)	(2.02)	(.080)		
1/53 - 9/79	.000	.894	.897	.0022	
	(.00001)	(.163)	(.026)		
					3.04
					(3,366)
1/53 - 12/83	.000	.714	.820	.0023	
	(.00002)	(.133)	(.030)		

B. Huizinga - Mishkin

$$\pi_t = \alpha + \beta\, i_t + \gamma_1 \pi_{t-1} + \gamma_2 \pi_{t-2} + \varepsilon_t \qquad (2)$$

Sample Period	α	β	γ_1	γ_2	$S(\varepsilon)$	F-test for Stability (Degrees of Freedom)
4/18 - 5/20	.003	3.31	.252	-.193	.0102	
	(.015)	(4.45)	(.199)	(.199)		
						8.47
						(4,109)
4/18 - 12/27	.003	-.682	.532	.101	.0091	
	(.003)	(1.06)	(.094)	(.094)		
1/53 - 9/79	-.001	.860	.177	.214	.0022	
	(.0003)	(.115)	(.054)	(.055)		
						8.43
						(4,364)
1/53 - 12/83	.000	.360	.332	.256	.0024	
	(.0002)	(.067)	(.051)	(.050)		

Note: π_t is the monthly C.P.I. inflation rate, i_t is the one-month nominal interest rate (either brokers' time loans or Treasury Bills), and L is the lag operator, $L^k X_t = X_{t-k}$. $S(\varepsilon)$ is the standard deviation of the residuals. The F-test for stability compares the fit from the overall sample period with the fit from estimating coefficients before and after the changes in "regime" (either 6/20 or 10/79).

Huizinga/Mishkin model in (2) for the 1918-27 and 1953-83 sample periods, and for the subperiods before the changes in regime, April 1918 - May 1920 and January 1953 - September 1979. Table 1 also contains asymptotic F-tests for the stability of the model parameters within the sample periods, similar to the tests performed by Huizinga and Mishkin. It seems from these results that the Huizinga/Mishkin model is unstable, with F-tests above 8.0 in both sample periods, whereas the Nelson/Schwert model is much more stable with F-tests of .63 in the 1918-27 sample period and 3.04 in the 1953-83 sample period. While the F-test over 3.0 is highly statistically significant, it is less than half the level produced by Huizinga and Mishkin. Note that the residual standard deviations are very similar in the Huizinga/Mishkin and the Nelson/Schwert models, indicating that these non-nested models fit the data equally well.

Perhaps one reason for the substantial difference in the stability of the Huizinga/Mishkin versus the Nelson/Schwert model is due to an implicit assumption about the stationarity of the variables and errors in these models. Both the nominal interest rate and the inflation rate behave like nonstationary stochastic processes (see Box and Jenkins [1976, Chapter 4]), similar to random walks. The Huizinga/Mishkin model assumes that there is a stationary regression error in the regression of one nonstationary variable on another. On the other hand, the Nelson/Schwert model is specified in terms of the first differences of inflation and the nominal interest rate, both of which behave like stationary processes. As discussed in Plosser and Schwert [1977, 1978] and in Plosser, Schwert, and White [1982], assumptions about stationarity can have important effects on the statistical properties of estimators and test statistics. While it is beyond the scope of this paper to resolve the difficult question of which specification is "best," it is clear that the magnitude of the change in the stochastic process for the real rate of interest is sensitive to the assumed model specification.

As a final point of clarification, it is important to note one major difference between the 1918-27 period and the 1974-83 period. Even though Huizinga and Mishkin argue that these episodes are similar in terms of a major change in monetary policy and the associated behavior of the real rate, the behavior of the nominal rate is quite different in these periods. Figure 3a contains a plot of the nominal rate and the real rate expressed as annual percentage rates from March, 1918 through December, 1927. While the real rate changes dramatically in 1920, the nominal rate is virtually constant. Figure 3b contains a plot of the nominal and real

Figure 3a

Real and Nominal Interest Rates

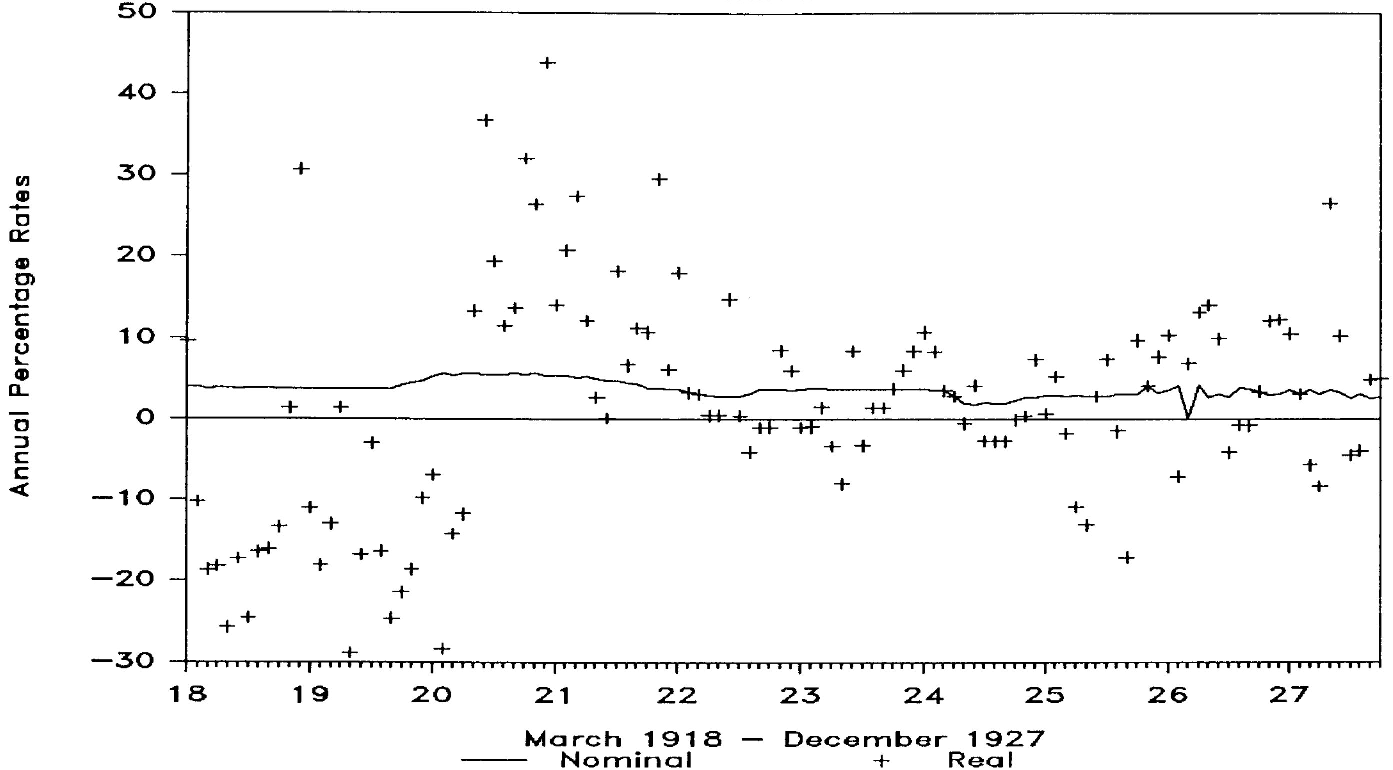
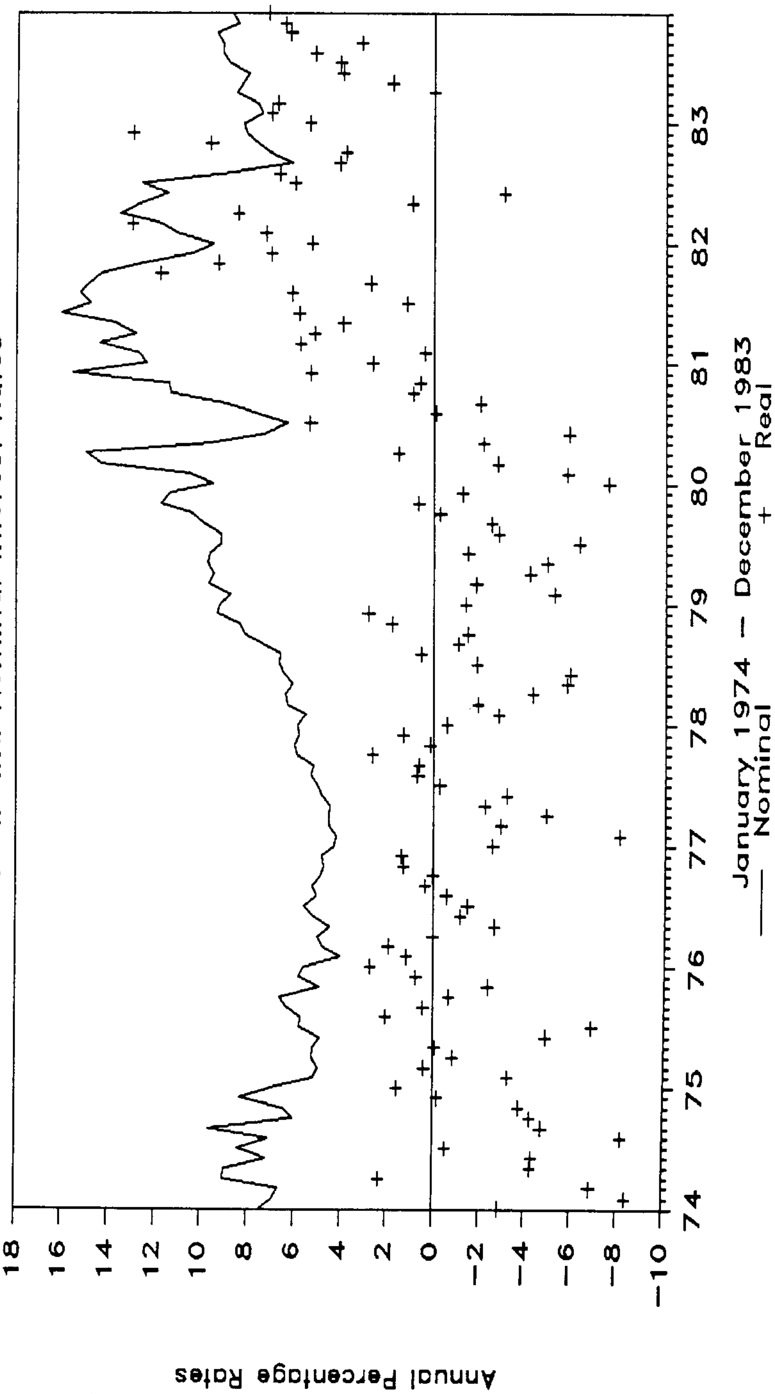


Figure 3b

Real and Nominal Interest Rates



rates from January, 1974 through December, 1983, and it appears that the nominal rate changes as much or more than the real rate in late 1979. In other words, the role of the inflation rate, which is the difference between the nominal rate and the real rate, is much more important in the 1918-27 period. Almost all of the dramatic rise in the real rate in this period is due to the post-World War I deflation. On the other hand, the behavior of the real rate since 1979 is largely due to high and variable nominal rates.

III. THE RELATION TO MONETARY POLICY

Even if one is willing to conclude that the stochastic behavior of real rates of interest changed in 1979, and possibly in 1920 (and possibly October, 1982), there remains the obvious question: What does this have to do with monetary policy? Huizinga and Mishkin argue vigorously that the coincidence of timing is striking evidence that the change in policy caused the change in behavior. Nevertheless, a skeptic could reasonably wonder why direct measures of monetary policy variables such as the growth rate of monetary base or the discount rate cannot be used directly to account for the observed behavior of the real rate. As noted by Huizinga and Mishkin, such variables have not been useful in explaining the behavior of real rates in previous studies. In addition, Huizinga and Mishkin show that changes in uncertainty about monetary growth, or inflation, or nominal interest rates cannot explain the apparent change in the behavior of real rates in 1979.

In effect, we have evidence that time series behavior of real rates changed, but we have no understanding of what specific factors caused that change. This raises the question of what is meant by a "change in policy regimes." Certainly these are not the only changes in monetary policy that have occurred between 1918-83. The beginning and end of the Federal Reserve-Treasury Accord, "Operation Twist," and a number of changes in discount rates could equally well be identified for study in a manner analogous to the 1920 and 1979 episodes. With the benefit of hindsight, I believe that the common experience of 1920 and 1979 is that the inflation rate fell dramatically in both periods, without an accompanying drop in nominal interest rates. Of course, this is equivalent to saying that real rates rose.

From this perspective, I do not think we have gained much in our understanding of why monetary policy affects the behavior of the real rate of interest. We remain puzzled about why nominal interest rates remained high and variable long after the inflation rate had fallen. Many of the papers in the references of the Huizinga/Mishkin paper analyze variables such as the budget deficit as possible factors that can help to explain the behavior of real rates, but none has found a reliable explanation for this phenomenon.

It is also worth noting that there are related studies not discussed by Huizinga and Mishkin that may shed light on the real rate puzzle. Plosser [1982] finds that unexpected increases in government spending are associated with decreases in nominal interest rates, which he interprets as evidence that the real interest rate is reduced. He finds no evidence that monetary policy variables are related to changes in nominal rates. Cornell and French [1985] study the response of daily future prices for goods (e.g., gold, silver, etc.) and Treasury Bills to money supply announcements between 1977-84. They find that the expected real rate of interest (defined by analyzing the relative price of goods versus Bills) does not respond to money supply announcements from October, 1977 to September, 1979, or from October, 1982 to March, 1984. During the October, 1979 to September, 1982 period there are statistically significant responses of expected real rates to money supply announcements, although the change in the nominal rate is about twice as large.

IV. CONCLUSIONS

The Huizinga/Mishkin paper raises important questions about the behavior of the real rate of interest. It argues, perhaps too strongly, that the October, 1979 to October, 1982 period was an important change in monetary policy "regimes," and that this had a substantial influence on the behavior of real rates. While the statistical evidence for a change in behavior is impressive (although qualified by some of the calculations in this paper), the mechanism which links monetary policy regimes to real rates remains a mystery. As I indicated in the introduction, it is clear that this evidence deserves further analysis.

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