Research Department
Federal Reserve
Bank of
San Francisco

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FRBSF Weekly Letter

Volatility and Unpredictability

In the seven weeks from June 28 to August 18, the new issue rate on large 90-day Certificates of Deposit (CDs) fell over 600 basis points to 9.5 percent. All interest rates fell in late August. For Treasury bills, the rates reached a two-year low. Was the recent decline in interest rates anticipated by the market, and what caused the rapid drop? The answer is that the decline was not anticipated, and it is hard to explain the magnitude of the drop even with the benefit of hindsight.

Large, unanticipated changes in interest rates make even short-term financial transactions risky. That is why market participants closely monitor interest rates. They hope that a careful reading of past movements will divulge the current objectives of Fed policy, help them to predict future interest rates, and allow them to divine the true state of the economy. However, extracting information about changes in the real economy or monetary policy from observed movements in interest rates is almost as tricky as predicting future changes in interest rates.

This *Letter* briefly analyzes the recent decline in interest rates. It examines and contrasts three factors: volatility—the absolute size of movements in rates, predictability—anticipated changes in interest, and *ex post* explanations—whether past movements can be attributed to specific "causal" factors.

Volatility: a historical perspective

When analyzing the recent decline in interest rates it is important to keep in mind the past pattern of interest rates. Since late 1979, the volatility of interest rates has increased dramatically. From 1977 through 1979, the average (absolute) monthly change in 90-day CD rates was 33 basis points. From January 1980 through July 1982, the average (absolute) monthly change was 150 basis points. Volatility increased approximately fourfold.

In July, the monthly average 90-day CD rate fell by 120 basis points. In August, it fell by 290 basis points. Viewed as isolated changes, these substantial drops appear to indicate something significant; however, viewed relative to previous monthly changes since 1979, the decline is not unusual. Monthly changes over 100 basis points occurred in almost two-thirds of the months since 1979. Changes greater than 300 basis points occurred 10 percent of the time. Cumulative two-month average changes exceeded 400 basis points 20 percent of the time.

Volatility and unpredictability

Volatility does not necessarily measure the unpredictability of a series. Some series have large seasonal or trend components that are easily predicted. For example, strawberries are a seasonal product with a sharply variable price. But it is easy to predict that the average price of strawberries in January will exceed the average price of strawberries in July.

Predictable price changes, such as those due to seasonal movements, do not increase risk. If the changes were expected in advance, long-term plans or contracts could incorporate them.

Financial analysts and the financial press gamely publish predictions of future interest rates, leading one to presume that interest rates, like the price of strawberries, may be volatile but predictable. The frequent reversals in opinion suggest, however, that accurate interest rate predictions are difficult to make. Participants in financial markets, nevertheless, must predict future interest rates every day; they put their money on their predictions.

Any multiperiod financial instrument is a contract that contains an implicit bet about future short-term rates. The market's current prediction of future short-term rates is incorporated in the longer term rate. Any fore-

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caster who disagrees with the market's prediction implicit in longer term rates can make or lose a great deal of money by betting against the market. This is done either by selling or buying financial instruments or financial futures contracts. Moreover, if investors bet heavily against the market, current rates will change.

A two-period example illustrates the basic point. Consider a hypothetical case in which an investor can buy a 60-day CD that yields 10 percent or two 30-day CDs in successive periods. The 30-day CD pays a rate of 10 percent in the first month and 20 percent in the second month, giving an average yield of 15 percent over two months. Investors will attempt to purchase the two 30-day CDs because the total yield exceeds the 60-day CD rate. Banks will wish to sell the 60-day CD. When the market clears, buyers and sellers must agree on the same price. The yield on 60-day CDs will rise and the total yield on 30-day CDs will fall until the total yields for sixty days will be equal for both types of CDs. The rate on the 60-day instrument is, therefore, the geometric average of the two shorter term CD's.

In actual financial markets, the future rate—the rate for the second CD, is not known today and must be predicted. The current 60-day rate and the current 30-day rate, called spot rates, are known. Because the market will equilibrate the yields on these two investment plans, knowing that the 60-day rate is the geometric average of the 30-day rates allows us to work backwards to calculate the future rate. For example, the forward rate—the 30-day CD rate implied for the next period—is about 14 percent when the current 60-day rate is 12 percent and the current 30-day rate is 10 percent.

If interest rates form a volatile but predictable series, forward rates will deviate from current spot rates, but forward rates will be accurate forecasts of future spot rates.

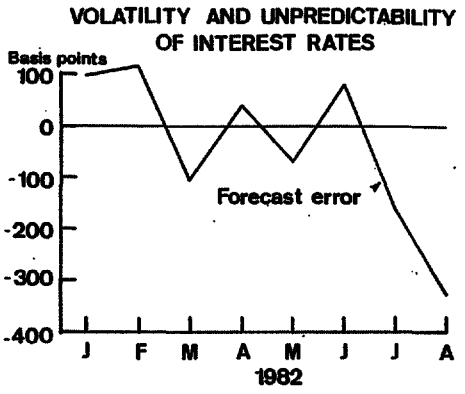
To assess the accuracy of the predictions implicit in forward rates, I subtracted the one-month forward rate for 90-day CDs from the actual CD rate that occurred one month later. I have used this difference to represent forecasting error and to measure the unpredictability in interest (CD) rates. From 1977 through 1979, the average (absolute) error was 36 basis points. From 1980 through July 1982, the average (absolute) error was 150 basis points. By this measure, unpredictability increased fourfold. The volatility measure discussed earlier and the unpredictability measure are virtually the same. One might say that random walks would have predicted as well as the forward rate.

Interest rates are volatile *and* unpredictable. The market did not expect rates to decline in July or August. In fact, forward rates for July and August show that the market actually expected an increase in rates.

The chart shows what I call the market forecast error for 1982. It is the difference between the monthly average 90-day CD rate and the forward rate predicted one month earlier. The July error of −161 basis points, while large, is only slightly above the average error for the two and one half year period since the change in Fed operating procedures. The August error of −336 basis points is a whopper. Nevertheless, the market made errors this large in about 15 percent of the months since 1979.

Predictable vs. explainable

Although there is ample evidence that changes in interest rates are extremely hard to predict even one month ahead, this does not mean that they cannot be explained. *Ex post* hindsight is usually keener than foresight. To explain past movements in interest rates, there must be a stable correlation between the unanticipated change in interest rates and the change in "causal" variables. If the causal variables are unpredictable, they explain why interest rates changed *ex post*, but they provide no assistance in forecasting.



By working backwards, however, unanticipated changes in interest rates may provide valuable information about changes in the causal variables themselves. For example, economic theory posits that the demand for money depends on income (money for transactions balances) and interest rates (financial assets are substitutes) plus other less important influences. Therefore, changes in interest rates, which can be observed daily, may provide information about current changes in the real economy or in the Federal Reserve's policy intentions. This information is valuable because money and income can only be observed with a lag.

As an example of an *ex post* relationship, I regressed the unanticipated change in CD rates on the monthly growth of non-borrowed reserves, an indicator of monetary policy, and the growth in industrial production, an indicator of real activity in the economy. The results showed that roughly 80 percent of the unanticipated change in CD rates, in the sample history period from January 1960 through August 1982, could be explained by changes in nonborrowed reserves and industrial production.

In July and August, nonborrowed reserves grew rapidly, putting downward pressure on interest rates. However, using the historical relationship, the growth in nonborrowed reserves only explained about one-third of the decrease in interest rates and industrial production was virtually unchanged. In short, most of the recent unanticipated drop in CD rates cannot be explained *ex post* by the simple historical relationship.

Summary and conclusions

Interest rates are extremely volatile and unpredictable. I examined one-month ahead predictions for 90-day CD rates using the forward rate as the market forecast. The average (absolute) forecast error over the past 32 months was 150 basis points—a large error for a one-month ahead forecast. Forecasting further in the future would be even more treacherous.

The unpredictability of interest rates makes financial transactions risky, their timing and maturity critical. Purchasers of CDs in June, for example, received a substantially higher interest rate than those who purchased CDs in August.

An investor who believes interest rates will fall in the future would try to lock in the current rate with a long maturity intrument, while one who believes interest rates will rise will go into short maturities until the rate rises. The unpredictability in rates makes these term structure gambles extremely risky.

The July and August rate decline was not anticipated by the market. Furthermore, the observed monetary stimulus does not seem to have been large enough to explain the decline in rates. The lack of a solid *ex post* explanation of observed changes in interest rates makes investors and policymakers nervous. Does the decline signal a real economy that is weaker than preliminary data indicates, or have investors' expectations suddenly changed? In either case, what does it mean for the future? If the real economy were so weak, why is the stock market booming? And if investors' expectations changed suddenly in the past, will they change again in the future? At the moment, the market seems to be hedging its bets—the August forward rate for September is predicting a 1 percent increase in CD rates.

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BANKING DATA—TWELFTH FEDERAL RESERVE DISTRICT

(Dollar amounts in millions)

Selected Assets and Liabilities Large Commercial Banks	Amount Outstanding 9/15/82	Change from 9/8/82	Change from year ago Dollar	Percent
Loans (gross, adjusted) and investments*	162,100	738	9,852	6.5
Loans (gross, adjusted) — total#	142,193	731	10,907	8.3
Commercial and industrial	45,762	638	6,538	16.7
Real estate	57,439	– 15	3,036	5.6
Loans to individuals	23,525	16	499	2.2
Securities loans	2,542	163	1,006	65.5
U.S. Treasury securities*	6,556	90	841	14.7
Other securities*	13,351	– 83	– 1,896	– 12.4
Demand deposits — total#	42,354	564	329	0.8
Demand deposits — adjusted	28,020	38	– 114	– 0.4
Savings deposits — total	31,424	– 224	1,573	5.3
Time deposits — total#	99,042	– 134	13,790	16.2
Individuals, part. & corp.	89,191	– 188	12,080	15.7
(Large negotiable CD's)	37,010	– 89	3,025	8.9

Weekly Averages of Daily Figures	Week ended 9/15/82	Week ended 9/8/82	Comparable year-ago period
Member Bank Reserve Position			
Excess Reserves (+)/Deficiency (–)	100	140	62
Borrowings	142	14	20
Net free reserves (+)/Net borrowed(–)	– 42	126	42

* Excludes trading account securities.
\# Includes items not shown separately.

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