Has Financial Market Volatility Increased?

By Sean Becketti and Gordon H. Sellon, Jr.

There is a widespread perception that financial market volatility has increased during the 1980s. While the collapse in stock prices in October 1987 has drawn the most attention, many investors and financial market analysts believe that the volatility of interest rates and exchange rates has risen as well.

If financial market volatility has increased, there may be important consequences for investors and policymakers. Investors may equate higher volatility with greater risk and may alter their investment decisions in light of increased volatility. Policymakers may be concerned that financial market volatility will spill over into the real economy and harm economic performance. Alternatively, policymakers may feel that increased financial volatility threatens the viability of financial institutions and the smooth functioning of financial markets.

The purpose of this article is to examine the claim that financial volatility has increased in the 1980s. That is, are the volatilities of returns on stocks, bonds, and exchange rates historically high in the 1980s? The article finds that financial market volatility has indeed increased; yet the nature of the volatility, its magnitude, and its persistence are very different across markets.

The first section of the article examines why financial market volatility is important to investors and policymakers. The second section provides statistical evidence on the volatility of returns in the stock, bond, and foreign exchange markets. The third section discusses the response of investors and policymakers to increased financial volatility.

Why volatility matters

Financial markets and institutions play a key role in the economy by channeling funds from savers to investors. Some volatility in the prices of financial assets is a normal part of the process of allocating investable funds among competing uses. Excessive or extreme volatility of

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stock prices, interest rates, and exchange rates may be detrimental, however, because such volatility may impair the smooth functioning of the financial system and adversely affect economic performance.

Stock market volatility

Much of the recent concern over financial market volatility has centered on the stock market and the collapse in stock prices that occurred on October 19, 1987. The 508 point drop in the Dow-Jones average on October 19 was the largest one-day percentage drop in history. Stock market volatility of this magnitude could harm the economy through a number of channels.[1]

One way that stock price volatility hinders economic performance is through consumer spending. For example, immediately after the October 19 drop in stock prices, economic forecasters predicted sharply weaker economic growth. These analysts believed that the fall in stock prices would reduce consumer spending. The sizable fall in consumer wealth was expected to directly lower consumer spending. In addition, a weakening in consumer confidence could contribute to a further spending reduction.[2]

Stock price volatility may also affect business investment spending. Investors may perceive a rise in stock market volatility as an increase in the risk of equity investments. If so, investors may shift their funds to less risky assets. This reaction would tend to raise the cost of funds to firms issuing stock. Moreover, small firms and new firms might bear the brunt of this effect as investors gravitated toward the purchase of stock in larger, well-known firms.[3]

Extreme stock price volatility could also

disrupt the smooth functioning of the financial system and lead to structural or regulatory changes. For example, the commissions studying the October 19 stock price collapse focused their attention on the stock-order execution and market-making systems. Systems that work well with normal price volatility may be unable to cope with extreme price changes. Indeed, the system itself may contribute to volatility if investors are unable to complete stock transactions. Changes in market rules or regulations may be necessary to increase the resiliency of the market in the face of greater volatility.[4]

Interest rate volatility

The 1980s have also seen increased concern over interest rate volatility. In the early 1980s, rising inflationary expectations, restrictive monetary policy, and removal of interest rate ceilings contributed to high and volatile interest rates. Like stock market volatility, extreme interest rate volatility may hurt economic performance and disrupt the smooth functioning of the financial system.

One way in which interest rate volatility may harm the economy is through business investment spending. Investors may see an increase in the volatility of interest rates as an increase in the risk of holding bonds and other debt instruments. If investors shift their portfolios toward lower risk assets, firms may find it more costly to fund investment projects. The resulting fall in investment spending would reduce economic growth.

Interest rate volatility could also have a direct impact on monetary policy. If higher rate volatility causes investors to change their investment portfolios, the demand for money may also change. To the extent that monetary policy is

based on an assumed stable relationship between money and economic activity, changes in money demand due to rate volatility could complicate monetary policy.[5]

Greater interest rate volatility could also weaken the financial system if this volatility threatens the viability of financial intermediaries.[6] Increased interest rate volatility is a serious problem for depository intermediaries, such as savings and loans, that have long-term assets and short-term liabilities.[7] An increase in rate volatility can lead to periodic liquidity crises for some of these institutions and may threaten the solvency of others. Regulatory actions, such as an increase in capital requirements, may be necessary to protect these institutions from increased volatility of interest rates.

Exchange rate volatility

In 1973 the major industrialized countries abandoned the Bretton Woods system of fixed exchange rates in favor of a floating rate system. Since 1973 there has been continuing concern that exchange rate volatility under the new system might adversely affect international trade and capital flows.[8]

Like volatility in the stock market and interest rates, exchange rate volatility may create uncertainty about future profits, which impairs long-term investment decisions. Companies involved in international trade may be reluctant to commit to long-term investment projects if they fear that exchange rate changes might significantly reduce profits.

A second way that exchange rate volatility might impede international trade is through higher prices for exports and imports. If companies add a risk premium to the prices of internationally traded goods because of

exchange rate uncertainty, consumers may reduce the amount of the higher priced goods they demand and slow the growth of world trade.

Finally, exchange rate variability may alter international capital flows. Long-term capital flows may be reduced by greater exchange rate uncertainty, impeding the efficient flow of resources in the world economy. At the same time, increased exchange rate volatility may promote short-term, speculative capital flows. These speculative capital flows may complicate monetary policy. Central banks may be forced to intervene frequently in exchange markets or to adjust monetary policy to prevent these capital flows from having adverse effects on the domestic economy.

## Measuring financial market volatility

Because financial volatility matters to investors and policymakers, it is important to examine the claim that volatility has increased during the 1980s. This section presents evidence supporting the view that volatility has increased across financial markets in the 1980s. However, the nature, the magnitude, and the persistence of the increase in volatility differ across markets.

Stock market volatility

Most discussions of stock market volatility center on the large price movements on and around October 19, 1987. To put these events in proper perspective, however, it is useful to examine stock market volatility over a longer time span.

Viewing the stock market over a longer time horizon, some observers have concluded that the volatility of stock returns in the 1980s is not

CHART 1
Volatility of stock returns, 1918-88

Standard deviation
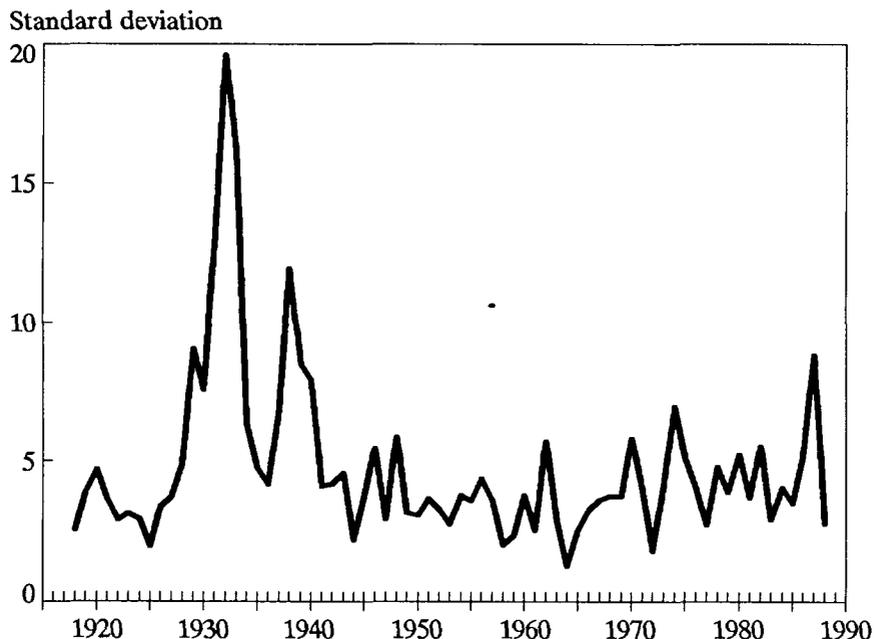
Note: In this chart, volatility is measured by the annual standard deviation of monthly stock returns. See endnote 9 for details.

Source: Center for Research in Security Prices.

unusual. For example, Chart 1 shows the volatility of stock returns from 1918 to 1988. The measure of volatility used in this chart is the annual standard deviation of the monthly returns in the Standard and Poor 500 Composite Stock Price Index.[9] According to this chart, record stock market volatility occurred in the 1930s. Compared with the 1930s, stock market volatility in the 1980s does not appear abnormal.[10]

The relevance of this extended historical comparison is open to question, however. Most observers regard the economic turbulence of the 1930s as an extraordinary historical episode, one unlikely to be repeated. Thus, a more recent perspective on volatility may be in order. Examining Chart 1 from 1950 to 1988 shows that stock market volatility in 1987 was the highest in the postwar period.

Focusing on October 19, 1987, suggests a way of resolving these differing opinions on stock market volatility. The key feature of the October 19 period is the sharp one-day movements in stock prices. Stock prices fell 108 points on Friday, October 16, and an additional 508 points on October 19 before rising 102 points on October 20. In each case, stock price changes were considerably above normal daily price movements.

CHART 2

Normal volatility of stock returns, 1918-88

Interquartile range
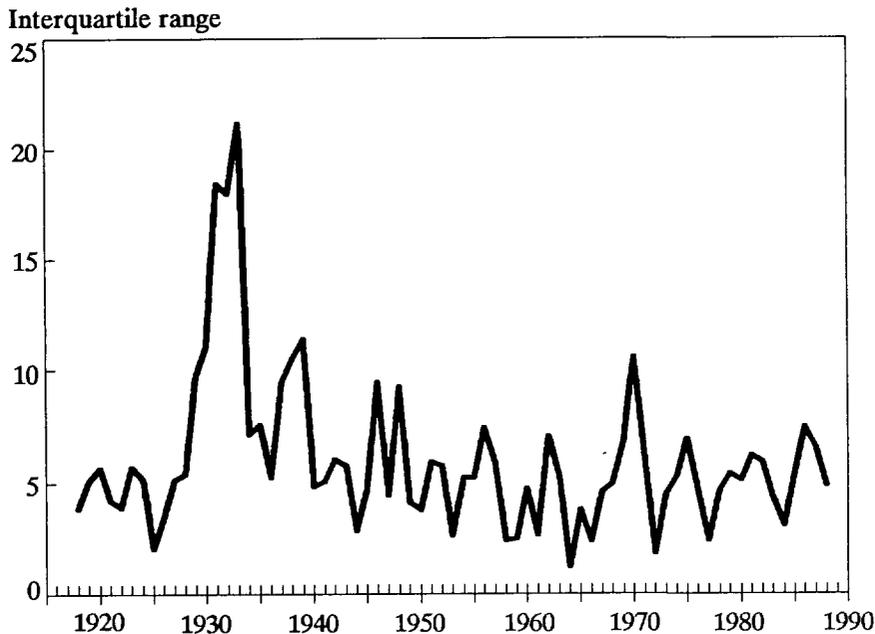
Note: In this chart, volatility is measured by the annual interquartile range of monthly stock returns. See endnote 11 for details.

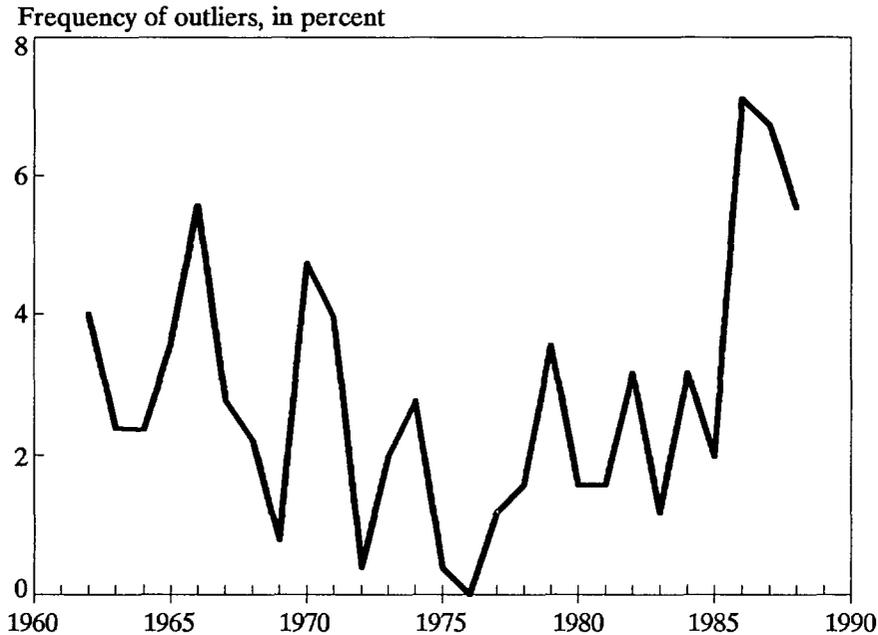Source: Center for Research in Security Prices.

It is possible to think of stock market volatility as including two parts, normal volatility and jump volatility. Normal volatility refers to the ordinary variability of stock returns, that is, the ordinary ups and downs in returns. Jump volatility, on the other hand, refers to occasional and sudden extreme changes in returns.

An analogy may be useful in showing the distinction between normal volatility and jump volatility. The tidal rise and fall of the ocean resembles the normal volatility of stock returns. Tidal swings may be more or less pronounced at different times of the year, but tidal changes have a regularity and smoothness that capture

the idea of normal volatility. Occasionally, however, violent weather or offshore earthquakes suddenly produce extreme changes in the level of the water and in the severity of wave actions. These disruptions are like jump volatility. In this analogy, the collapse of stock prices on October 19, 1987, was like a tidal wave.

Using a measure of normal volatility, there is no evidence that normal stock market volatility has increased in the 1980s. Chart 2 shows a measure of normal volatility that excludes extreme price changes.[11] By use of this measure, the volatility of stock prices is not historically high. Indeed, with this measure, peak stock

CHART 3
Frequency of jumps in stock returns, 1962-88

Frequency of outliers, in percent

Note: In this chart, volatility is measured by the percentage of days in each year that experienced unusually large daily stock returns, either negative or positive. See endnote 12 for details.

Source: Center for Research in Security Prices.

market volatility in the postwar period occurs in 1970, not 1987.

Jump volatility in the stock market, as measured by the frequency of extreme price changes, does seem to be higher in the 1980s, however. Chart 3 shows the percentage of daily stock returns that are extremely high or low in a given year.[12] According to this measure of volatility, the frequency of large stock price movements in 1987, as well as in 1986 and 1988, is considerably greater than in any other year since 1966. Thus, this measure of volatility suggests that jump volatility in stock returns may

have risen in the 1980s.[13] However, it should be noted that with only three years of increased volatility, additional evidence would be needed to support the view that there has been a permanent change in the jump volatility of stock returns.

Interest rate volatility

Unlike the mixed evidence regarding volatility in the stock market, all measures of interest rate volatility show sharply higher volatility in the 1980s. In the early 1980s, financial markets

CHART 4

Volatility of Treasury bill yields, 1926-87
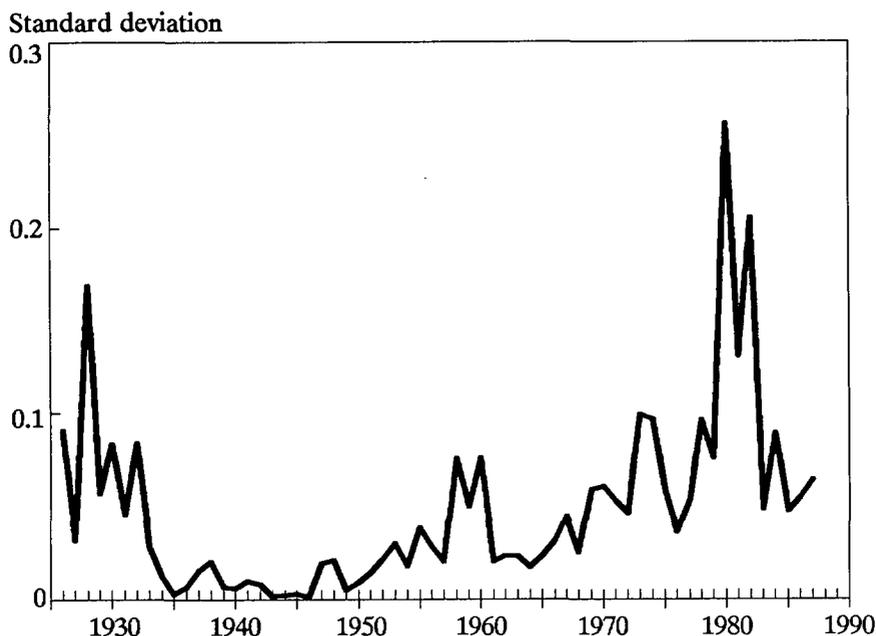
Standard deviation

Note: In this chart, volatility is measured by the annual standard deviation of monthly returns of a one-year Treasury bill index.

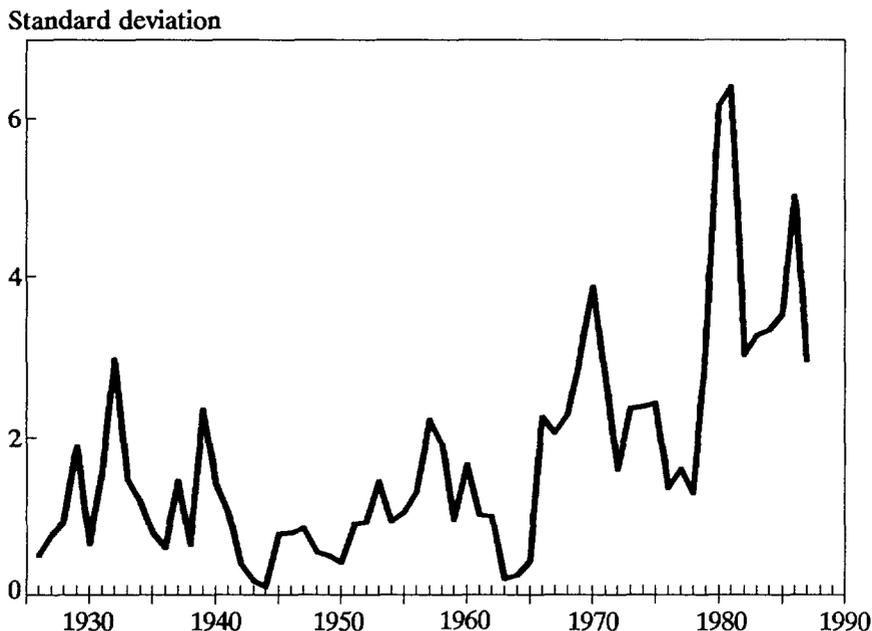Source: Center for Research in Security Prices.

experienced large shifts in inflationary expectations, a change in monetary policy procedures that permitted greater short-term interest rate volatility, and widespread deregulation. These factors contributed to greater volatility of interest rates at all maturities.

The dramatic increase in the volatility of short-term interest rates during the 1980s is illustrated in Chart 4. This chart shows the annual standard deviation of the monthly returns on a one-year Treasury bill index from 1926 to 1987. As seen in this chart, short-term interest rate volatility reached record levels in the early 1980s. However, since 1982 volatility appears to have subsided to more normal levels. Thus, the increase in the volatility of short-term interest rates in the early 1980s appears to have been a temporary phenomenon.

In contrast, the increased volatility of long-term interest rates in the 1980s has been sustained. Chart 5 shows the volatility of returns on 20-year Treasury securities from 1926 to 1987.[14] According to this chart, the volatility of long-term interest rates shifted upward once in the late 1960s and early 1970s, and volatility increased again in the early 1980s. Moreover,

CHART 5

Volatility of Treasury bond yields, 1926-87

Standard deviation

Note: In this chart, volatility is measured by the annual standard deviation of monthly returns of a 20-year Treasury bond index.

Source: Center for Research in Security Prices.

although volatility has fallen from the 1981-82 peak, it remains historically high. Unlike volatility of short-term interest rates, the volatility of long-term rates in the 1980s seems to be permanently higher.
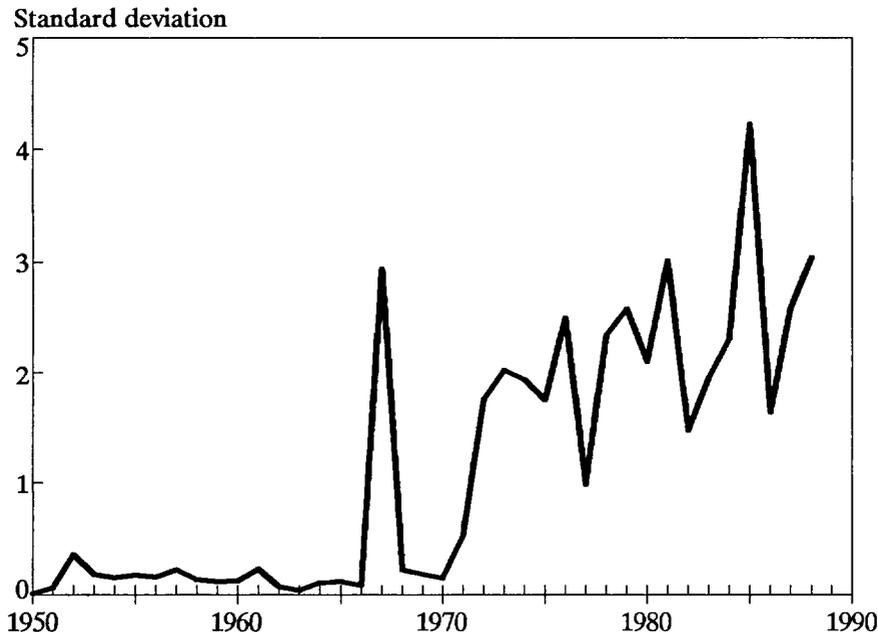
Exchange rate volatility

The measurement and interpretation of exchange rate volatility are more complicated than for stock and bond markets. Historically, exchange rates have been subject to considerable governmental controls. In the postwar period,

for example, there have been two major exchange rate regimes, the Bretton Woods system of fixed exchange rates from 1946 to 1972, and a system of floating exchange rates since 1973. Moreover, during the floating-rate period, governments have intervened at times to stabilize foreign exchange markets or to realign currency relationships.

In moving from a fixed to a flexible system of exchange rates, exchange rate volatility should rise. Indeed, as shown in Chart 6, volatility after 1973 is significantly greater than in the earlier postwar period.[15] However, many analysts

CHART 6

Volatility of the dollar/pound exchange rate, 1950-88

Standard deviation

Note: In this chart, volatility is measured by the annual standard deviation of monthly percentage changes in the nominal U.S. dollar/pound sterling exchange rate.

Source: Board of Governors, Financial Markets section.

expected increased volatility to be temporary until foreign exchange traders adapted to the new system. Chart 6 shows that, contrary to expectations, exchange rate volatility has shown no tendency to diminish after 1973.

A closer look at the 1973-88 floating-rate period suggests that exchange rate volatility actually increased further during the 1980s. Chart 7 shows the volatility of the trade-weighted value of the dollar.[16] Dividing the period at 1980 demonstrates that the average volatility of the dollar, shown by the horizontal line, is higher in the 1980s than in the 1970s.[17]

Thus, in the foreign exchange market as in the stock and bond markets, there is evidence of greater financial volatility in the 1980s.

Responses to increased financial volatility

In the presence of increased financial market volatility, investors may alter their investment strategies, and policymakers may pursue regulatory reforms. Investors have two options to cope with greater volatility. They can shift their investment portfolios toward less risky assets,

CHART 7
Volatility of the trade-weighted dollar, 1974-88
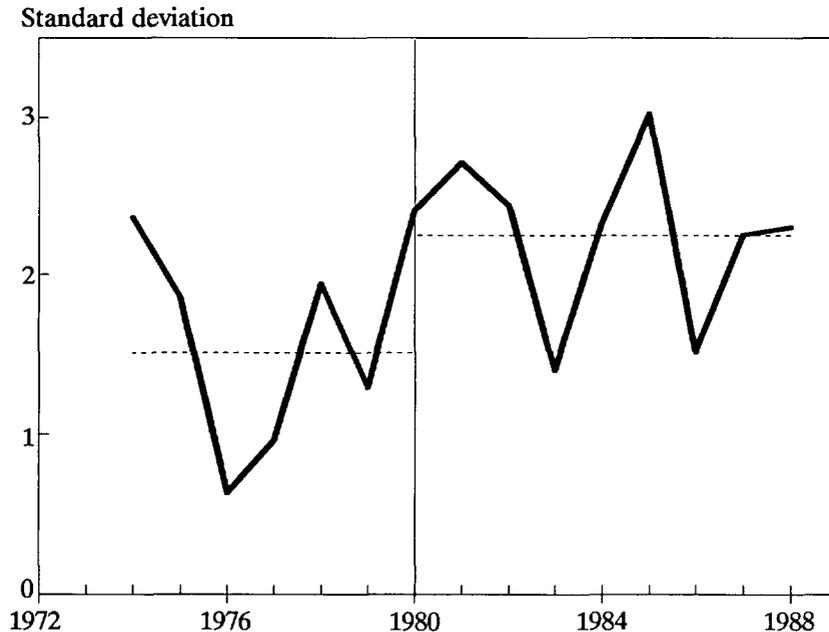
Standard deviation

Note: In this chart, volatility is measured by the annual standard deviation of monthly percentage changes in the index of the nominal trade-weighted value of the dollar published by the staff of the Board of Governors. The horizontal dashed lines show the average volatility of the dollar before and after 1980.

Source: Board of Governors, Financial Markets section.

or they can attempt to immunize the value of their portfolios. Policymakers can also pursue either of two options. They can try to reduce volatility directly, or they can assist financial markets and institutions in adapting to increased volatility. Some investors have attempted to adjust to volatility by restructuring their portfolios. An example is the sharp drop in stock purchases by individual investors after October 19, 1987. Individual investors reduced their direct purchases of stocks and also shifted away from stock mutual funds. As a consequence, retail stock brokerages and mutual funds have

experienced reduced profitability and have scaled back operations and employment.

In the face of a general increase in financial volatility, however, investors may find it difficult to protect themselves through portfolio restructuring. For example, investors have generally considered bonds to be less risky than stocks. With increased stock market volatility, investors might prefer to shift into bonds. However, as shown in the previous section, bond market volatility has increased dramatically in the 1980s. Indeed, as shown in Chart 8, the unprecedented upsurge in volatility in the 1980s

CHART 8

Volatility of stock returns and Treasury bond yields

Standard deviation
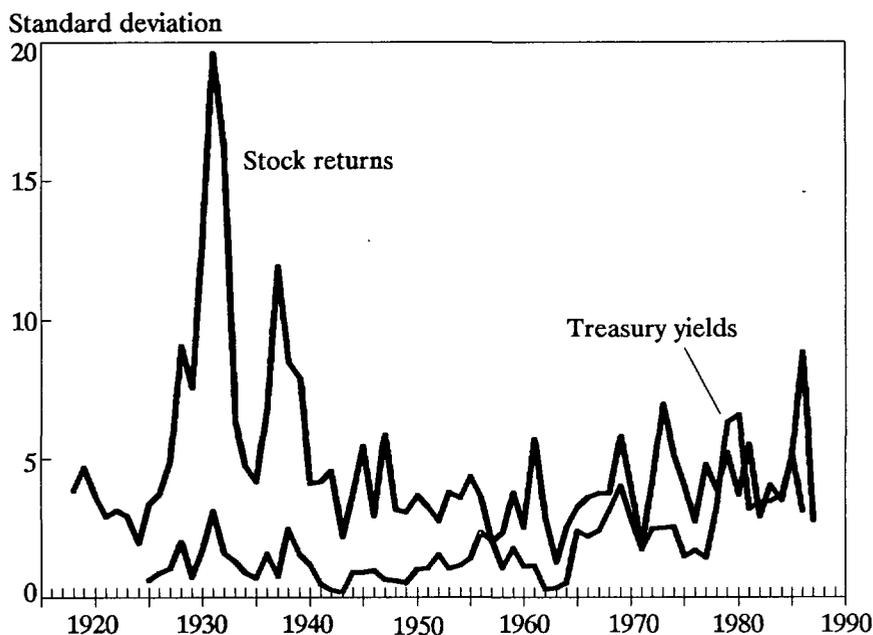
Note: In this chart, volatility is measured by the annual standard deviations of monthly stock returns and 20-year Treasury bond returns.

Source: Center for Research in Security Prices.

has made fixed income investments as risky as stocks. In this environment, risk averse investors may be inclined to move away from any type of long-term investment.

The 1980s have also seen explosive growth in hedging and immunization strategies by individual and institutional investors. Individual investors, corporations, and financial institutions are increasingly using interest rate futures, swaps, and options for protection against greater interest rate volatility.[18] Similarly, stock index futures and options are now widely employed to manage stock market volatility.[19] And, cor-

porations and other institutions involved in international trade now use similar instruments to reduce their exposure to exchange rate volatility.

For the most part, policymakers have shown little inclination to attempt to reduce financial volatility directly. For example, proposals to reduce interest rate volatility and stock market volatility through regulation have received little support. Moreover, although governments have intervened in foreign exchange markets to prevent disorderly markets, they have generally rejected proposals to return to a system of fixed

exchange rates.

In contrast, policymakers have attempted to increase the ability of financial markets and institutions to adapt to greater volatility.[20] For financial institutions directly exposed to increased volatility, such as depository institutions and market makers, policymakers have encouraged greater capitalization. Increased capital allows these institutions to weather greater financial volatility without incurring the liquidity and solvency problems that might disrupt the functioning of financial markets.

Summary and conclusions

The 1980s have seen increased volatility in many financial markets. The nature of the volatility, its magnitude, and its persistence differ across markets. In the stock market, there is no evidence that normal stock return volatility is different in the 1980s than in previous periods. The frequency of large one-day price movements, however, is considerably higher in each of the past three years.

The volatility of interest rates at all maturities increased sharply at the beginning of the 1980s. The volatility of short-term rates has since declined to historical levels. However, the volatility of long-term rates has continued to be unusually high. Indeed, during the 1980s the volatility of returns on long-term Treasury securities has been as great as stock volatility.

Exchange rate volatility has been considerably higher during the flexible-rate system than under the pre-1973 regime of fixed exchange rates. Even so, exchange rate volatility during the 1980s is generally higher than in the early years of floating exchange rates.

Investors and policymakers have had to adapt to increased financial volatility. Investors have shown some evidence of shifting toward less risky, short-term assets. Investors have also made increasing use of hedging and other portfolio immunization strategies. For the most part, policymakers have resisted pressures to reduce financial volatility directly through increased regulation. Instead, policymakers have attempted to improve the ability of financial markets and institutions to weather increased volatility.

Endnotes

[1] For an overview of some of the channels by which the stock market might affect the economy, see Bryon Higgins, "Is a Recession Inevitable This Year?" *Economic Review,* Federal Reserve Bank of Kansas City (January 1988), pp. 3-16.

[2] For evidence on the impact of the fall in stock prices on consumer spending, see C. Alan Garner, "Has the Stock Market Crash Reduced Consumer Spending?" *Economic Review,* Federal Reserve Bank of Kansas City (April 1988), pp. 3-16.

[3] A discussion of how financial fluctuations affect the economy is found in Mark Gertler and R. Glenn Hubbard, "Financial Factors in Business Fluctuations," *Financial Market Volatility* (Federal Reserve Bank of Kansas City, 1989), pp. 33-72.

[4] Two widely cited reports on the October 1987 stock market decline are: U.S. Presidential Task Force on Market Mechanisms, *Report of the Presidential Task Force on Market Mechanisms,* Washington, D.C., January 1988; and Working Group on Financial Markets, *Interim Report of the Working Group on Financial Markets,* Washington, D.C., May 1988.

[5] For evidence on the linkage between interest rate volatility and money demand, see C. Alan Garner, "Does Interest Rate Volatility Affect Money Demand?" *Economic Review,* Federal Reserve Bank of Kansas City (January 1986), pp. 25-37.

[6] The implications of greater interest rate volatility for financial institutions are discussed in Charles S. Morris, "Managing Interest Rate Risk with Interest Rate Futures," *Economic Review,* Federal Reserve Bank of Kansas City (March 1989), pp. 3-20. Potential costs of interest rate volatility are also discussed in Raymond Lombra and Frederick Struble, "Monetary Aggregate Targets and the Volatility of Interest Rates: A Taxonomic Discussion," *Journal of Money, Credit and Banking* (August 1979), pp. 284-300.

[7] A more detailed discussion of interest rate risk and savings and loans is contained in Charles S. Morris and Thomas J. Merfeld, "New Methods for Savings and Loans to Hedge Interest Rate Risk," *Economic Review,* Federal Reserve Bank of Kansas City (March 1988), pp. 3-15.

[8] See, for example, Keith E. Maskus, "Exchange Rate Risk and U.S. Trade: A Sectoral Analysis," *Economic Review,*

Federal Reserve Bank of Kansas City (March 1986), pp. 3-15.

[9] The data in Chart 1 are obtained from the Center for Research in Security Prices (CRSP). These returns are the nominal monthly percentage capital gain in the Standard & Poor's index of 500 stocks. These returns exclude dividend yields. Statistics for the returns including dividend yields are virtually identical to those displayed in Chart 1.

The measure of volatility pictured in Chart 1 and in most of the succeeding charts is the annual standard deviation of monthly returns. This is a measure of the dispersion of monthly returns about the average return for each year. More precisely, if $r_{i,t}$ is the return for month i in year t and $\bar{r}_t$ is the average monthly return in year t, then the annual standard deviation of monthly returns for that year is

$$\sigma_t = \left(\frac{\sum_{i=1}^{12} (r_{i,t} - \bar{r}_t)^2}{11} \right)^{\frac{1}{2}}.$$

For a more detailed look at the distribution of stock returns after 1949, see *"Stock Market Volatility,"* Carolyn D. Davis and Alice P. White, Staff Study No. 153, Board of Governors of the Federal Reserve System, August 1987.

[10] This finding that the stock market volatility of the 1980s is not unusually high when compared with the volatility of the 1930s is also reported in Robert J. Shiller, "Causes of Changing Financial Market Volatility," with *Financial Market Volatility* (Federal Reserve Bank of Kansas City, 1989), pp. 1-22.

[11] To measure normal volatility, what statisticians call a robust measure of scale is required. The statistic displayed in Chart 2 is the fourth spread, a statistic that is essentially the same as the interquartile range, the distance between the 25th and 75th percentile of the monthly returns within the year. For an explanation of the fourth spread and of its superiority to the standard deviation in measuring normal volatility, see Boris Iglewicz, "Robust Scale Estimators and Confidence Intervals for Location," *Understanding Robust and Exploratory Data Analysis,* edited by David C. Hoaglin, Frederick Mosteller, and John W. Tukey (New York: John Wiley & Sons, Inc., 1983). Note that in the special case where returns are normally distributed,

$$\text{fourth spread} \approx 1.35\sigma_t.$$

[12] The measure of jump volatility depicted in Chart 3 is related to the measure of normal volatility shown in the previous chart. First, the fourth spread of the daily returns for each year is calculated. Then, two critical values, the upper and lower adjacent values, are calculated as follows:

upper adjacent value = 75th percentile + 1.5 (fourth spread)
lower adjacent value = 25th percentile − 1.5 (fourth spread)

Any daily returns that are either higher than the upper adjacent value or lower than the lower adjacent value are classified as outliers, that is, as extremely high or low returns relative to the rest of the daily returns in that year. Chart 3 displays for each year the number of outliers divided by the number of trading days in the year, that is, the percentage of daily stock returns that are unusually high or low. The statistical justification for this measure of outliers is discussed in David C. Hoaglin and Boris Iglewicz, "Fine-Tuning Some Resistant Rules for Outlier Labeling," *Journal of the American Statistical Association*, vol. 82 (December 1987), pp. 1147-49.

[13] This finding is consistent with the statistics reported in Steven P. Feinstein, "Stock Market Volatility," *Economic Review*, Federal Reserve Bank of Atlanta (November/December 1987), pp. 42-47. Feinstein finds no evidence for a recent increase in the volatility of stock returns when the measure of volatility is the absolute monthly return. On the other hand, when the measure of volatility is the monthly standard deviation of daily returns, the 13 months from October 1986 through October 1987 do exhibit abnormal volatility. It is well known that the standard deviation is extremely sensitive to outliers, in this case, to jumps in daily returns.

[14] The volatility of Treasury bonds is measured as the annual standard deviation of the monthly returns on a 20-year con-stant maturity Treasury bond index.

[15] The volatility of exchange rates in this chart is measured as the annual standard deviation of the monthly return on the U.S. dollar/pound sterling exchange rate.

[16] The volatility of the exchange rate in this chart is calculated using the index of the trade-weighted value of the dollar published by the staff of the Board of Governors. Because this measure begins in 1967, it was not used to make the longer historical comparison in Chart 6.

[17] The difference in average volatilities of the trade-weighted dollar pictured in Chart 7 is statistically significant at the 5 percent level. Greater exchange rate volatility in the 1980s is also reported in Jacob A. Frenkel and Morris Goldstein, "Exchange Rate Volatility and Misalignment: Evaluating Some Proposals for Reform," *Financial Market Volatility* (Federal Reserve Bank of Kansas City, 1989), pp. 185-219.

[18] See, for example, Morris, "Managing Interest Rate Risk . . ."; Morris and Merfeld, "New Methods for Savings and Loans . . ."; and Gregg Whittaker, "Interest Rate Swaps: Risk and Regulation," *Economic Review*, Federal Reserve Bank of Kansas City (March 1987), pp. 3-13.

[19] For an introduction to stock index futures and their use as hedging instruments, see Charles S. Morris, "Managing Stock Market Risk with Stock Index Futures," *Economic Review*, Federal Reserve Bank of Kansas City (June 1989), pp. 3-16.

[20] There has also been increased recognition by policymakers that stable macroeconomic policies contribute to financial market stability. See, for example, Craig Hakkio, "Exchange Rate Volatility and Federal Reserve Policy," *Economic Review*, Federal Reserve Bank of Kansas City (August 1984), pp. 18-31.