Economic Review

FEDERAL RESERVE BANK OF KANSAS CITY

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What Policy for Mergers?

Stock Prices and the Economy

Money Growth Volatility,
Uncertainty, and High Interest Rates

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Bank Deregulation And Concentration– What Policy for Mergers?

By Wilbur T. Billington

Nebraska and Oklahoma joined a long list of states this year allowing banking organizations to expand beyond a single location. Not only do both states allow limited branching, they also allow multibank holding companies. Kansas is the only state in the Tenth District still adhering strictly to unit banking.[1]

The changes in Nebraska and Oklahoma are notable, given the conservative positions they have always taken on banking structure. The changes reflect a national trend toward product and geographic deregulation in banking.

While many look on deregulation with favor, it brings to center stage issues vital to the Federal Reserve System's role of central banker. For example, there is some concern that deregulation will make the financial system more fragile as fewer but larger organizations form its base. And as these fewer institutions develop national payments links, the change may affect how monetary policy actions are transmitted to the economy. Certainly, the impact of deregulation raises the importance of the System's need to be involved in both supervisory and monetary policy. While some may advocate that the Federal Reserve confine itself to monetary policy, such a change seems very ill advised, especially now during these rapidly changing and uncertain times.

Deregulation also has brought questions about the concentration of financial resources to the national policy agenda. As the country moves toward interstate banking, concern over concentration in banking being raised to unacceptable levels will no doubt be accentuated.

The following discussion of bank merger policy in an environment of deregulation and concentration highlights four elements: first, some of today's events bearing on tomorrow's banking structure; second, current levels of banking concentration related to political and geographic boundaries; third, traditional antitrust tools used to influence banking competition and concentration and their effectiveness in dealing with the emerging banking structure;

[1] States of the Tenth Federal Reserve District are Colorado, Kansas, Missouri, Nebraska, New Mexico, Oklahoma, and Wyoming.

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and, fourth, some suggestions on steps to be taken in preparing for a likely increase in national merger activity.

Events affecting deregulation of banking structure

Bankers have always wanted to compete and to see their organizations grow and flourish. Recent legislative, judicial, and regulatory events are now more encouraging to them in their expansion objectives.

On the legislative front, the changes in Nebraska and Oklahoma are only two of the most recent illustrations of a more liberal attitude toward bank expansion. Over the past two years, multibank legislation has passed in Pennsylvania, West Virginia, Arkansas, and Illinois. States such as Connecticut, Massachusetts, Maine, Alaska, South Dakota, and Delaware have recently allowed, within bounds, out-of-state banks to acquire banks within their borders. Several states are discussing how they might allow interstate banking within regional zones, such as the Southeast, the Northeast, and maybe the Northwest. There is also a mood on Capitol Hill that, while not yet clear, tends toward easing geographic restrictions.

On the judicial front, recent decisions also have made it easier for banking organizations to expand. Most notable has been the 1981 *Mercantile Texas Corporation* decision by the Fifth Circuit Court of Appeals, which limits the ability of regulators to block market extension proposals by increasing the evidentiary requirements on them.

On the regulatory front, federal banking agencies themselves, acting under the influence of recent court decisions or the need to meet financial emergencies, have taken a more liberal stance on bank consolidation. Early this year, for instance, Mellon National Corporation, Pennsylvania's largest banking organization, was allowed to acquire the state's seventh largest banking organization, the Girard Company. Shortly afterward, Interfirst Corporation, the largest banking organization in Texas, acquired First United Bancorporation, the state's tenth largest banking organization. Completing the picture of large bank consolidations is the approval given to BankAmerica to acquire the financially troubled SeaFirst Corporation.

These events have increased the concentration of financial resources. They also call into question how well traditional antitrust standards can be applied to influence events on a regional or national basis as emerging trends develop into a merger movement. Before going into these matters, however, it might be well to put the current level of concentration into perspective. After all, it is the level of concentration that dictates the speed at which answers are sought to deal with growing regional and national concentration.

Concentration of resources

The traditional way of looking at concentration has been to measure the share of resources controlled by the four largest firms in a geographical area. A possible caveat for banking is that this measure may overstate the true level of concentration in product markets. Today, there are reasonable, though not perfect, substitutes for the services supplied by commercial banks. Savings and loans come first to mind. Nevertheless, commercial banks are a dominant feature of the financial system, and there remains concern with the level of concentration in banking.

Nationwide, the four largest banking organizations control about a tenth of total bank deposits. In contrast, concentration in other key industries, like petroleum refining, steel, and automobiles, ranges from 30 to 90 percent. If

the Tenth District states are considered a region, the four largest organizations controlled 30 percent of total bank deposits in 1982. Of district states, Colorado is the most highly concentrated, with the four largest banking organizations controlling 53 percent of state bank deposits. Of the ten major metropolitan banking markets in the district, four-firm concentration ratios in 1982 ranged from 39 percent in Kansas City to 87 percent in Albuquerque.

These figures demonstrate a simple, but important, feature of the current banking environment. As the view of concentration moves from national boundaries, where banking restrictions are more stringent, to state and local boundaries, where mergers are more frequently allowed, concentration increases. These figures suggest, therefore, that as the laws continue to be liberalized, allowing more state and interstate mergers, concentration of financial resources also will increase.

This does not imply that the tendency is necessarily harmful. Removing barriers to entry across state lines could facilitate competition as firms seek new market opportunities. Nevertheless, when such entries are made through acquisition, banking concentration will tend to increase. And this tendency raises the question of whether present antitrust standards are adequate for dealing with the developing merger movement in a way that is consistent with a strong, competitive national banking system.

Current antitrust tools and banking

The current approach to reviewing bank mergers and acquisitions focuses on the effects on either existing competition or probable future competition. If a proposed merger or acquisition would combine two or more banks or companies competing in a market, existing competition would be affected. If the elimination of an existing competitor results in excessive local market concentration without offsetting public benefits, the proposal is denied.

In the event of banking organizations expanding statewide, the Federal Reserve System has analyzed the effect of such expansions on future competition. Where a banking organization tries to enter an already highly concentrated market through the acquisition of a leading bank, the Federal Reserve has denied the proposal if there was evidence that the acquiring firm would enter the market with a new bank or through acquisition of smaller banks. In this way, the System has been able to inhibit large market extension mergers where it concluded that competition could be better served by encouraging procompetitive entry. This policy also has tended to constrain increases in statewide concentration. Because of the evidentiary requirements imposed by the *Mercantile* decision, however, many believe that probable future competition will be less useful as a tool for analyzing interstate bank mergers.

Developing alternatives for dealing with national merger issues

The discussion so far has outlined the events prompting change in the structure of banking and focused on the sufficiency of current antitrust tools in meeting potential increases in banking industry concentration. From this review, it can be concluded that the analysis of bank mergers works well in some areas and not so well in others. For example, the analysis used in reviewing horizontal mergers will continue to be effective in controlling local banking concentration. There is no consensus, however, on the attitude that should be taken toward market extension proposals. Although there is currently no reason for alarm about concentration in banking, a sound and consistent policy must emerge soon to deal with prospective developments in banking structure.

Certain steps could be taken to develop such a policy. First, antitrust decisions could be reviewed again, especially those dealing with the national issue in other industries, to see what elements in those cases might apply to the emerging national trends in banking. Second, definitions of the geographic and product markets could be reexamined. It could be that the right tool is being applied to the wrong situation. Recent changes in national and state laws, services, and technology have clearly expanded the product and geographic scope of banking. A broader definition might show some smaller local mergers desirable while allowing better control of trends toward large regional or national concentrations of banking resources. Third, the use of probable future competition needs to be reevaluated to determine whether it remains a valid economic concept that can be effectively applied. It has been pointed out that for the concept to be effective, it must be simple, uniform, easily applied, and capable of resolving adversarial difference. If the evolution of merger policy reflects these criteria, it will be effective in providing a sound basis for dealing with the potential for increased concentration in banking.

Conclusion

Banking is not now highly concentrated, so there is time to explore alternatives for policies governing mergers. Any viable approach, however, must be formulated to be consistent with national goals to control concentration, with the national need to facilitate financial and economic growth, and with sound economic theory that will withstand market and legal review. Such a policy can and should be developed in view of the emerging trends in banking structure.

Stock Prices and the Economy

By Douglas K. Pearce

Common stock prices have climbed dramatically in the United States since the summer of 1982, with broad-based indexes rising more than 50 percent. Increases in stock prices also have been substantial in other industrial countries over this period. At first blush, the rise in stock prices might appear paradoxical, since stock prices began rising while unemployment rates in many of these countries were high. It has long been believed, however, that stock prices are a reliable leading indicator of economic activity, and the increase in stock prices in the United States has, indeed, been followed by a strong economic recovery.

While stock prices may signal future changes in the economy, they may also have direct effects on economic activity. The recent rise in U.S. stock prices has increased household wealth about a half trillion dollars, which many analysts believe should induce consumers to raise spending significantly and should speed the recovery. Investment spending on plant and equipment also is likely to be positively affected since higher share prices reduce the cost of raising funds and increase the incentive to expand productive capacity. New equity funding has been substantial during the stock market rally, ending a decade in which corporations relied almost exclusively on debt finance. The resulting lowering of debt-equity ratios of corporations is viewed as improving corporate stability.[1]

In view of the economic importance often ascribed to the stock market, this article reviews the theoretical and empirical literature on the relationship between stock prices and real economic activity. The first section discusses the stock market as a leading indicator and analyzes its record in predicting business cycle turns in the United States and other countries. The second section investigates the link between stock prices and the consumption decisions of households and examines the relevant empirical evidence. The third section considers the connection between stock prices and the investment decisions of firms and reviews the related empirical work. The fourth section looks at the estimated effect of the stock market rally on the

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[1] For a discussion of this issue, see Karlyn Mitchell, "Trends in Corporation Finance," *Economic Review*, Federal Reserve Bank of Kansas City, March 1983, pp. 3-15.

economy according to a large econometric model. The final section summarizes the findings of the article.

Stock prices as a leading indicator of business cycles

Business cycles refer to the irregular pattern of expansions and contractions that characterizes the time path of aggregate economic activity. The end of an expansion and start of a contraction is the cycle peak, while the end of a contraction and start of an expansion is the cycle trough. No mechanical formula is used to pick the months corresponding to peaks and troughs. Instead, a large number of indicators are used, based on historical experience. In the United States, the National Bureau of Economic Research is the authority that dates the turning points of the cycle. Economic agents and policymakers would benefit greatly if they could forecast these cycle turning points. Thus, it is not surprising that much effort goes into the search for reliable predictors, referred to as leading indicators.

Reasons for stock prices being a leading indicator

One time series that has long been used, either by itself or in combination with others, is an index of corporate stock prices. There are several views as to why movements in stock prices generally precede changes in real economic activity. According to the traditional model of stock prices, the price of a stock equals the present or discounted value of expected future dividends. In this model, stock prices rise because of higher expected corporate earnings or because of a lower required rate of return used by investors to discount future earnings. According to this model, stock prices should fall immediately if market participants lower their near-term expectations of corporate profits beause of a prospective economic downturn. Stock prices would then decline before the actual fall in corporate earnings and general economic activity. The price decline would occur even if stock prices have no direct effect on the economy. Because expectations of future corporate profits can be erroneous, however, the stock market could send false signals about future economic fluctuations.

A rise in the rate used to discount future earnings also would lead to an immediate fall in stock prices because it would lower the present value of expected earnings. The higher discount rate might result from more uncertainty about future corporate profits or from higher returns on other assets, such as a rise in the real interest rate on bonds. The fall in stock prices would be followed by an economic downturn if the source of the higher discount rate, say, a rise in the real rate of return on corporate bonds, also depressed the economy with some time lag or if lower stock prices had a direct negative effect on the economy. In either case, the stock market would act as a leading indicator of business fluctuations.[2]

Another view of why stock prices may lead economic activity emphasizes psychological elements. According to this interpretation, stock prices are not determined by the tradi-

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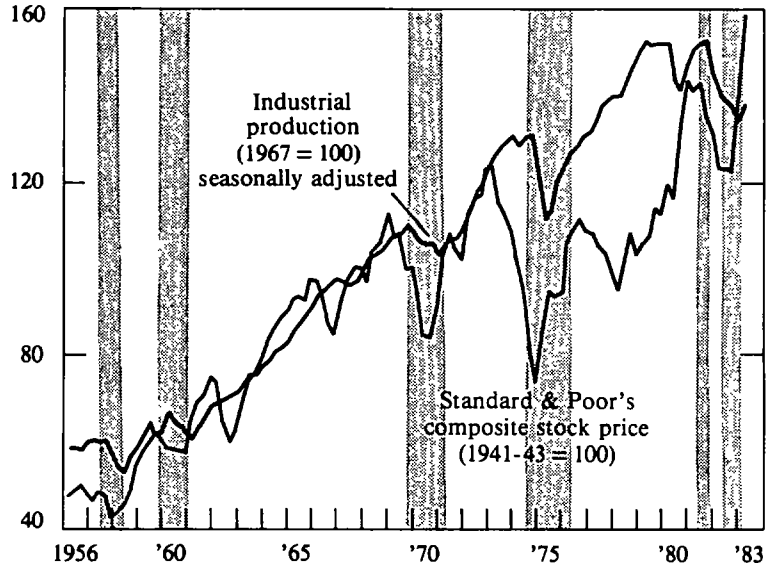
[2] The discussion above assumes that changes in expected corporate earnings or changes in the required rate of return used to discount future earnings do not simply reflect changes in expected inflation. If market participants abruptly raise their expectations of inflation, both expected nominal corporate earnings and the nominal rate of discount would rise immediately but stock prices would not change initially. Nominal stock prices would rise subsequently with inflation and real stock prices would be unaffected. This result depends on inflation being neutral in the sense of leaving expected real corporate earnings and the real rate of discount unchanged. For a more detailed treatment of this issue, see Douglas K. Pearce, "The Impact of Inflation on Stock Prices," *Economic Review,* Federal Reserve Bank of Kansas City, March 1982, pp. 3-18.

CHART 1
Stock prices and industrial production in the United States



tional model. Rather they move with the general level of optimism or pessimism, or what Keynes called "animal spirits." Stock prices begin to rise when people decide the economy is improving and are thus willing to make financial investments in such risky assets as common stocks. In this case, it is the state of confidence rather than a forecast of higher corporate earnings that moves share prices. However, since changes in optimism may result in changes in the required rate of return, the traditional model of stock prices does allow for such psychological events. Again, to the extent such optimism or pessimism is unfounded, stock price movements may prove poor indicators of business cycle turning points.[3]

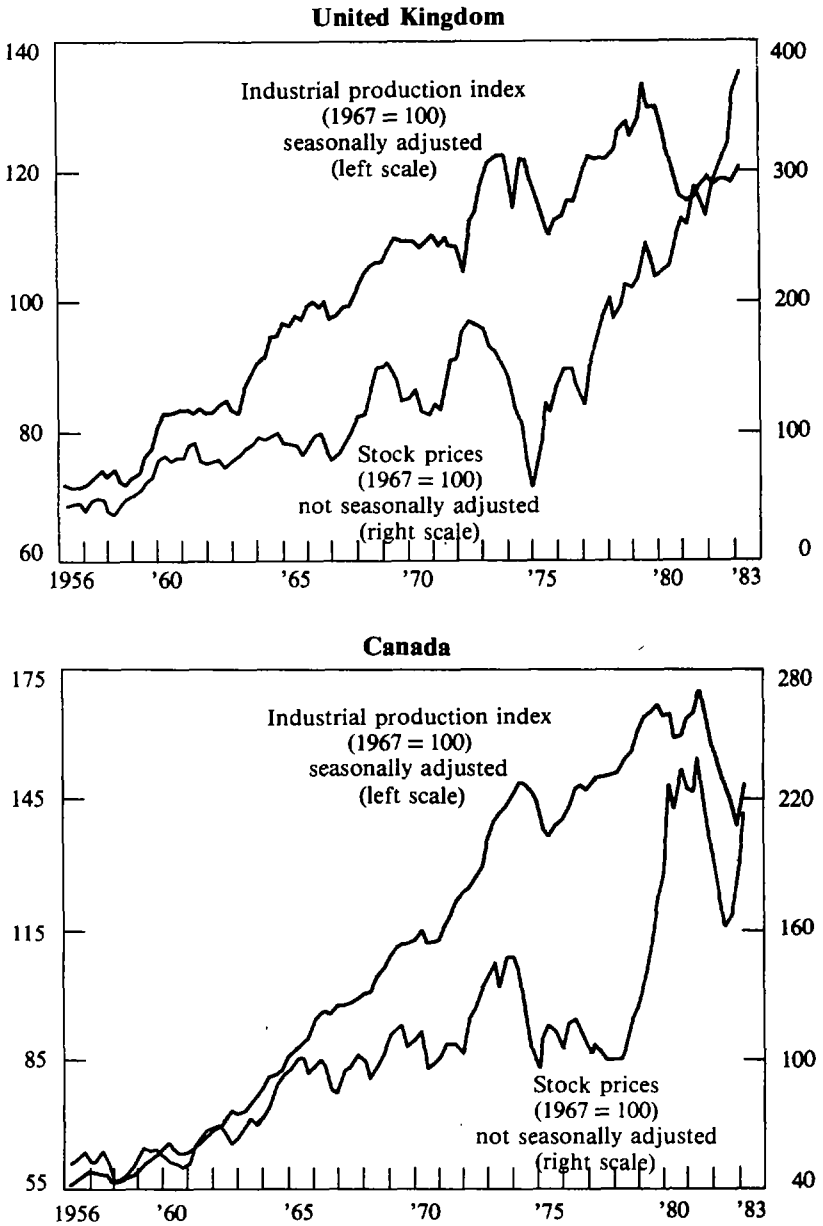
Evidence on the reliability of stock prices as a leading indicator

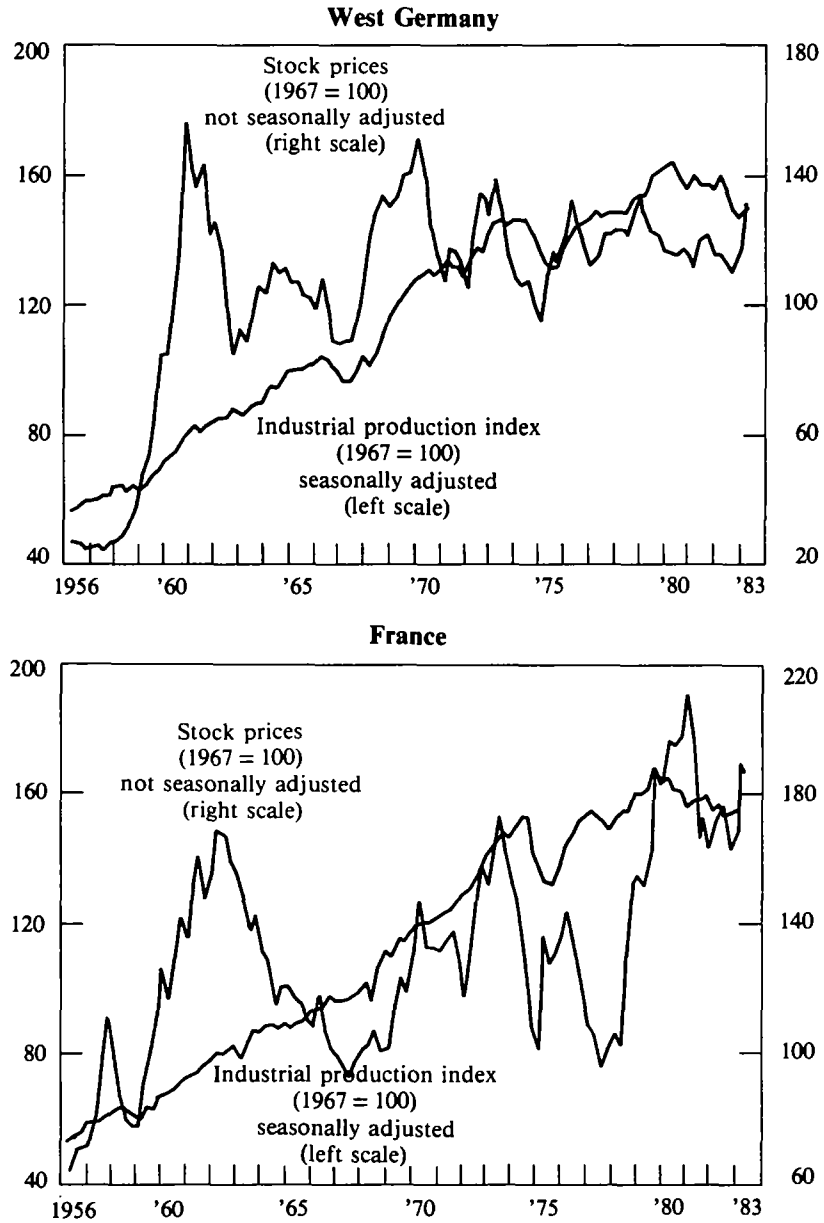
A relevant question is how good a guide have stock prices been in predicting economic upturns and downturns. Chart 1 plots the level of stock prices, as measured by Standard and Poor's Composite Index of 500 of the largest stocks, and the index of industrial production since 1956. The index of industrial production is classified as a "coincident indicator." This means that turning points in industrial production are thought to be synchronous with turning points in the general economy. The shaded areas in the chart represent periods of economic recession. The chart illustrates several points. First, stock prices generally started to decline before recessions began. A notable exception

[3] Another view has been advocated by Beryl Sprinkel, *Money and Stock Prices,* Irwin, 1964, who argues that both stock prices and the economy are reacting to movements in the money supply but that stock prices react more quickly to the change in the money supply and thus lead the subsequent change in real economic activity.

CHART 2

Stock prices and industrial production in selected countries




West Germany
Stock prices
(1967 = 100)
not seasonally adjusted
(right scale)
Industrial production index
(1967 = 100)
seasonally adjusted
(left scale)
200
160
120
80
40
180
140
100
60
20
1956
'60
'65
'70
'75
'80
'83
France
Stock prices
(1967 = 100)
not seasonally adjusted
(right scale)
Industrial production index
(1967 = 100)
seasonally adjusted
(left scale)
200
160
120
80
40
220
180
140
100
60
1956
'60
'65
'70
'75
'80
'83

was the short contraction in 1980, when stock prices were trending upward before and during the recession. Second, stock prices began to rise in all cases before the beginning of an economic expansion, usually about midway through the contraction. The recent steep climb in stock values, then, is characteristic of historical patterns. Third, the stock market occasionally gave false signals of contractions, particularly in the long expansion of the 1960s. Stock prices fell sharply in 1962 and in 1966, but no downturn in the general economy followed. Growth was slower, however, after each of these stock price downturns. Stock prices also declined from mid-1976 through 1977 with no subsequent contraction in economic activity. The record in the United States, therefore, indicates that while the stock market is not an infallible guide to turning points, it usually has moved downward before the contractions and always has risen before expansions.

The value of stock prices as an indicator of cyclical movements is less clear in other industrial economies. Chart 2 presents the history of stock prices and industrial production for several countries. Periods of recession are not indicated because business cycle peaks and troughs are not available for these countries. In the United Kingdom, stock price movements have been comparatively smooth, except for the 1969-76 period. Share values declined before the no-growth period of mid-1969 through 1972, and they fell sharply before the 1975-76 downturn, but they did not predict the recession that began in the first quarter of 1979. Upturns in stock prices have usually preceded upturns in the economy, so the rise in prices in the United Kingdom over the last two years would be consistent with a recovery.

Similar patterns appear in the Canadian data. However, the sharp decline in industrial production from the second quarter of 1980 to the second quarter of 1982 was accompanied rather than preceded by a slide in stock prices. For both West Germany and France, there seems to be little connection between stock price movements and industrial production. Several instances of sharp declines in stock prices were not followed by economic contractions. On the basis of this somewhat casual evidence, it appears that stock prices are much less reliable leading indicators in these countries than in the United States.

The stock market and consumption decisions

One reason the stock market is a leading indicator of the general economy is that fluctuations in stock prices may have direct effects on aggregate spending.[4] Movements in stock prices may affect both consumption spending by households and investment spending by firms. This section examines the connection between stock price movements and the consumption-saving decision of households.

The main channel by which stock prices are thought to influence consumption is through a wealth-consumption relationship. An increase in stock prices, with no change in consumer prices, raises the real net wealth of households. There is a debate, however, about whether the resulting real wealth fluctuations have a predictable effect on real consumption.

Wealth and consumption

The influence of wealth on the consumption decisions of households has long been an issue among economists. Although Keynes mention-

[4] As discussed above, stock prices could be a leading indicator of economic activity without a direct connection between the two. Both stock prices and the economy may be influenced by a common factor but stock prices may react faster.

ed that wealth changes would likely affect consumption, the emphasis in Keynesian consumption functions has been on the effect of disposable income rather than wealth.[5] In such models, saving is viewed as a residual rather than as part of a longer range plan. Subsequent research, however, has given a prominent role to wealth.

The most influential analysis in recent research is the life-cycle theory of saving.[6] According to this theory, households project their resources over their expected lifetimes and decide on the consumption flows that best suit their preferences. The constraint on households is that the present value of their planned consumption over the years must equal the present value of their expected incomes.[7] Part of households' expected incomes comes from their holdings of such tangible assets as real estate, stocks, and bonds, with the remainder being their expected labor incomes. The present value of future income from assets should equal the market price of the assets. Thus, household wealth is considered an important determinant of current consumption spending.

Suppose, for example, that a household has an expected lifetime of 25 years and wants the same level of consumption every year. The life-cycle model predicts that the household would allocate any increase in wealth evenly among the 25 years. Thus, for example, an increase in the household's net wealth of $1,000 would increase the household's consumption spending by $40 [= $1,000/25 years] every year over its lifetime.[8]

Household stockholdings and consumption

A substantial proportion of household wealth is held in the form of corporate stock, although equities have become a significantly smaller fraction over the past decade. Chart 3 shows the percentage of households' total assets and financial assets comprised by corporate stock over the last 25 years. These percentages steadily declined from 1969 to 1981, falling to less than a sixth of total wealth and a third of total financial assets.[9] Households were net sellers of corporate stock throughout the 1970s, probably because of the low returns on equities relative to such assets as owner-occupied housing.[10] Since June 1982, however, households have seen the market

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5 John Maynard Keynes, *The General Theory of Employment, Interest and Money,* Harcourt, Brace, 1936, pp. 92-3.

6 Albert Ando and Franco Modigliani, "The 'Life Cycle' Hypothesis of Saving: Aggregate Implications and Tests," *American Economic Review,* March 1963, pp. 55-84.

7 Formally, the constraint faced by the household is:

$$\sum_{t=0}^{n} \frac{C_t}{(1+r)^t} = \sum_{t=0}^{n} \frac{Y_t}{(1+r)^t}$$

where C_t = real consumption in period t
Y_t = real income in period t
r = discount rate
n = number of years expected to live.

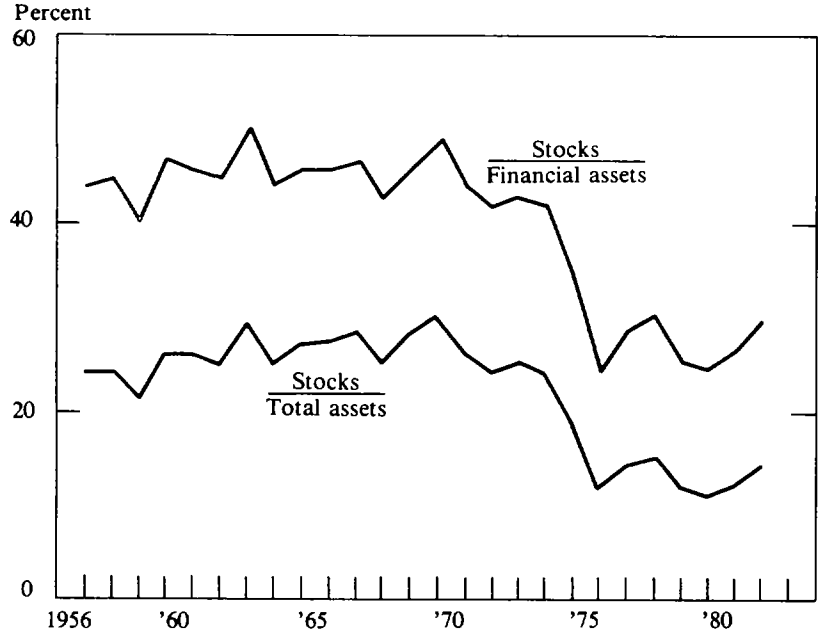
This ignores bequests, B, but these can be accounted for by adding the present value of bequests, $B/(1+r)^n$, to the left-hand side.

8 This assumes, for simplicity, that the interest rate is zero. If the interest rate is positive, consumption would rise more than $40 a year.

9 For descriptions and sources of the underlying asset data, see Laurence Kantor, "The Impact of Inflation Uncertainty on Households and the Neutralizing Effect of Inflation Hedging," *Economic Review,* Federal Reserve Bank of Kansas City, September/October 1983. Chart 3 slightly overestimates the decline in the share of assets held in stocks because long-term bonds are evaluated at par rather than at market value as are the other assets. While bond prices fell over the 1970s as interest rates rose, the share of bonds in total assets was always less than 4 percent. Over the 1969-81 period, household stockholdings rose in nominal value about 44 percent while total assets rose 188 percent.

10 The rise in the nominal value of household stockholdings over this period reflects capital gains rather than new stock purchased. The buyers of stock were institu-

CHART 3
Percentage of household assets in stocks



value of their stocks rise about $500 billion. A pertinent question is whether this capital gain has led to an increase in consumption as predicted by the life-cycle model.

Analysts have raised several issues regarding the relationship between stock market gains or losses and household consumption. One issue is whether gains realized from selling stock have a greater impact on consumption than gains accrued on stocks not sold. Some researchers argue that realized gains have a larger effect because households are in some way constrained from borrowing or reducing their saving from other sources to finance consumption. Other investigators, who say that realized gains have a greater effect, believe households view accrued capital gains as partly transitory.[11]

A second issue in the stock market-consumption relationship concerns the distribution of stockholders across wealth classes. Although about 33 million U.S. residents hold corporate stock directly, wealthy people own the vast majority of stock. One analyst estimates that, in 1973, households in the top 1 percent of the wealth distribution (net wealth in excess of $500,000) owned about 60 percent of the total corporate stock held by households, while the

tions, such as insurance companies and pension funds. For a discussion of why corporate stocks had low returns in the 1970s, see Pearce, "The Impact of Inflation on Stock Prices."

[11] The belief that consumers treat capital gains as partly transitory has led to consumption functions in which an average of current and past gains appears. This specification implies past market values are used to form "expected" or "permanent" stock market wealth. This approach conflicts with the notion of an efficient stock market in which past stock price changes do not help to predict future movements. For a discussion and assessment of this theory, see Eugene F. Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work," *Journal of Finance*, May 1970, pp. 383-417.

top 5 percent of the wealth distribution (net wealth in excess of $137,000) held about 85 percent.[12] To the extent that the wealthiest investors have low marginal propensities to consume out of wealth, large stock price movements may have only a small effect on aggregate consumption. This reservation is somewhat offset, however, by a large number of households owning stock indirectly through private pension funds. If the life-cycle model is correct, an increase in the value of pensions should raise current consumption because pensions also raise total lifetime resources and reduce the need to save for retirement.

A third issue is that it may be difficult to separate the effects of stock price changes on consumption from the effect of interest rate changes on consumption. According to the traditional model of stock prices, a decline in the real interest rate (the nominal rate less expected inflation) should raise stock prices because it increases the present value of expected real corporate earnings. A fall in the real interest rate also may simultaneously raise consumption directly if, as some analysts argue, households save less of their income when the real interest rate declines. An increase in total consumption, therefore, may accompany rising share prices even if there is no causal link between wealth and consumption. The fall in the real interest rate may cause both real wealth and consumption to increase.

A fourth issue also concerns the existence of a causal connection between stock price movements and changes in household consumption. Some investigators suggest that the stock market serves as a barometer of consumer confidence and the stock price-consumption association merely reflects the influence of greater confidence rather than greater wealth as implied by the life-cycle model.

Empirical evidence

Several studies have estimated the effect of stock market gains on aggregate consumption. The original tests of the life-cycle saving hypothesis found that household wealth had a significant effect on consumption, with an increase in wealth of one dollar leading to an increase in consumption of about six cents.[13] This work did not directly address the issue of whether capital gains from higher stock prices raise consumption, however, since wealth was not disaggregated by type. Thus, the separate influence of stocks was not examined.

Two subsequent studies of the relationship between stock market gains and aggregate consumption from the end of World War II to the mid-1960s reached conflicting conclusions. The results of the first study indicated that stock market gains had no discernible effect on consumption.[14] The author attributed this finding to the highly skewed distribution of stockholdings, arguing that the wealthy disregarded fluctuations in the stock market when making consumption decisions. The second study, however, obtained a significant estimated impact of capital gains on consumption over essentially the same period, with the magnitude of the effect being compatible with the life-cycle model.[15] This study also found that realized capital gains had a substantially larger effect than accrued gains. Several differences between the two studies may account for the disparity in

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12 Daphne Greenwood, "An Estimation of U.S. Family Wealth and Its Distribution from Microdata, 1973," *Review of Income and Wealth,* March 1983, pp. 23-44.

13 Ando and Modigliani, "The 'Life Cycle' Hypothesis."

14 John J. Arena, "Postwar Stock Market Changes and Consumer Spending," *Review of Economics and Statistics,* November 1965, pp. 379-91.

15 Kul B. Bhatia, "Capital Gains and the Aggregate Consumption Function," *American Economic Review,* December 1972, pp. 866-79.

results. The first analyst defined consumption to include the purchase of consumer durable goods while the second added only an estimate of the services from durables. The second study also employed a broader measure of capital gains and allowed for a longer time lag in the effect of market gains on consumption.

Further support for a positive relationship between stock market gains and consumption has appeared in more recent research. One analyst concluded that household expenditures on nondurables and services are strongly related to movements in the real value of stockholdings but that durable purchases are unrelated to gains on stock.[16] His results indicated that previous capital gains also raised current consumption, suggesting that households average past gains when making consumption decisions rather than simply using current gains. A more recent study also found a statistically significant positive effect of current stock market gains on aggregate consumption over the period 1960-77, an era of substantial stock market swings.[17] Finally, evidence on consumption behavior of individual households from survey data indicated that capital gains on stocks raise consumer expenditures.[18]

The weight of the empirical evidence supports a significant association between stock market gains and consumption. Households appear to spend from 3 to 7 percent of such gains. It is less clear whether realized gains have more impact than accrued gains or whether households use an average of past gains rather than current gains when planning consumption.[19]

The stock market and investment decisions

In addition to affecting household consumption, fluctuations in stock prices also are thought to influence the level of investment spending by firms. Higher stock prices are believed to encourage firms to acquire new equipment and structures, leading to an increase in the aggregate capital stock. This section discusses two major views of how stock prices may affect business fixed investment and then reviews the empirical evidence on the stock price-investment relationship.

Theoretical views of stock prices and corporate investment

The two views of how stock price movements influence corporate investment are usually referred to as the market-valuation approach (also known as Tobin's q approach) and the cost-of-capital approach. Both assume that

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16 Barry Bosworth, "The Stock Market and the Economy," *Brookings Papers on Economic Activity*, 2:1975, pp. 257-90.

17 J. Walter Elliott, "Wealth and Wealth Proxies in a Permanent Income Model," *Quarterly Journal of Economics*, November 1980, pp. 509-35.

18 Irwin Friend and Charles Lieberman, "Short-Run Asset Effects on Household Savings and Consumption: The Cross-Section Evidence," *American Economic Review*, September 1975, pp. 624-33. Bosworth, "The Stock Market and the Economy," however, found only weak evidence of a consumption-capital gains effect for an alternative data set on individual households.

19 The cited empirical studies do not shed light on the issue of whether the effects of stock price changes and interest rate changes on consumption are confounded, nor do they investigate whether stock price fluctuations are proxying changes in consumer optimism. On this latter issue, Saul H. Hymans reported that consumer attitude measures and stock prices are close substitutes in explaining automobile expenditures in his paper, "Consumer Durable Spending: Explanation and Prediction," *Brookings Papers on Economic Activity*, 2:1970, pp. 173-99. Franco Modigliani, on the other hand, found that a measure of consumer sentiment had only a negligible effect on consumption when wealth was accounted for. See "Monetary Policy and Consumption," in *Consumer Spending and Monetary Policy: The Linkages*, Federal Reserve Bank of Boston, June 1971, pp. 9-84.

managers seek to maximize the value of their firms when making investment decisions. In the market-valuation model, there is a simple, direct relationship between stock prices and investment. In the cost-of-capital model, stock prices affect investment indirectly by changing the cost of financing new capital expenditures, with other explanatory variables playing important roles in the investment decision.

The market-valuation model can be traced at least as far back as Keynes, who summarized the argument as follows:

> There is no sense in building a new enterprise at a cost greater than that at which a similar existing enterprise can be purchased; whilst there is an inducement to spend on a new project what may seem an extravagant sum, if it can be floated off on the Stock Exchange at an immediate profit.[20]

In other words, firm managers operating in the interests of the shareholders should only buy new equipment or structures when the market value of the firm is expected to rise more than the cost of the additional physical capital.[21] This is more likely to be the case when stock prices are relatively high. In a period of depressed stock prices, a firm that wants to expand its capacity may find it cheaper to buy an existing business's outstanding equity shares than to buy new capital. Investment does not increase in this case since ownership of existing capital changes but no new capital is forthcoming.

James Tobin formalized this approach by postulating that aggregate investment is positively related to the ratio of the total market value of firms to the replacement cost of their capital stock.[22] This ratio is known as Tobin's q. The market value of firms, the numerator of q, is the sum of the market value of outstanding equity and net debt. The replacement cost, the denominator of q, is the cost of replacing the existing capital stock at current prices. If the market value equals replacement cost, q equals one. In this case, firms have no incentive to change their capital stocks, and they would only replace worn-out equipment. Net investment, gross investment less depreciation, would be zero. If q exceeds one, say, because of a rise in stock prices, firms would want to increase their capital stocks and net investment would be positive. If q is less than one, firms would want to decrease their capital stocks and net investment would be negative.[23]

Several problems arise in the implementation of the market-valuation model. First, the q-ratio refers to all of a firm's capital, with no distinction made between new and old capital. If existing capital equipment becomes obsolete, the average q may be less than one while the q on new capital equipment exceeds one. In this case, the average q, which unlike the q on new equipment is observable, would likely be a misleading guide to investment spending.[24] Second, since the simple version of the market-valuation model ignores tax policy, modifica-

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20 Keynes, *General Theory*, p. 151.

21 The term capital is used in several contexts. Physical or real capital refers to the equipment and structures firms use to produce output. Financial capital refers to the funds firms raise—by selling bonds, borrowing at financial intermediaries, or selling equity—in order to purchase real capital.

22 James Tobin, "A General Equilibrium Approach to Monetary Theory," *Journal of Money, Credit, and Banking*, February 1969, pp. 15-29.

23 It is assumed that expansions (reductions) in the capital stock, all else constant, reduce (increase) the return on physical capital and hence reduce (increase) its market value so that q will move towards its equilibrium value of one. Adjustment costs prevent instantaneous adjustment.

24 For a discussion of the relationship between average q and q for new equipment, see Fumio Hayashi, "Tobin's Marginal q and Average q: A Neoclassical Interpretation," *Econometrica*, January 1982, pp. 213-224.

tions are required to take into account such factors as investment tax credits and differences in tax rates on dividends and capital gains. It has been shown that the equilibrium value of q—the value for which desired net investment is zero—is likely to be less than one when these tax considerations are incorporated in the model.[25] A third problem is the difficulty in calculating the replacement cost of existing physical capital because of the lack of well developed markets in used equipment and structures. An additional problem is that the denominator of q includes only reproducible capital while the numerator—the market value of the firm—presumably reflects not only physical capital but also managerial talent, patents, and other intangible assets. Fluctuations in the value financial investors place on these other factors may have little connection with the firm's decision to acquire new equipment.[26]

The cost-of-capital model also assumes that investment decisions are made to maximize the value of the firm, but in this framework investment involves a two-step process.[27] Firms first decide on the stock of real capital they want, based on expected sales and the prices of labor and capital services. The rate of investment is then determined by how fast firms want to reach the desired capital stock given significant adjustment costs. Unlike the market-valuation approach, this model gives fluctuations in expected sales, and hence planned output, an explicit role in affecting investment. Sales increases that are expected to continue lead to increases in investment even if stock prices remain constant.[28]

Changes in stock prices influence investment by changing the cost of physical capital services, usually referred to as the user cost of capital. In computing the cost of new physical capital, firms must consider the price of the new equipment or structure, the relevant tax laws, and the financial cost of the required funds. Consideration of this last factor is where stock prices appear. The financial cost of capital is generally measured by a weighted average of the cost of bond finance and equity finance, with the weights reflecting the proportions of the firm's assets financed by debt and equity. The cost of bond finance is measured by the after-tax corporate bond rate (since interest payments are tax deductible) less expected inflation. The cost of equity finance is the real rate of return required by shareholders, typically measured by the ratio of corporate earnings (dividends plus retained profits) to stock prices. A rise in stock prices with no increase in earnings reflects a lower required return, a lower cost of finance, and hence a lower user cost of capital. This lower cost should, in turn, encourage firms to acquire more physical capital and should increase net investment.

Problems also arise in the implementation of the cost-of-capital model. Unlike the market-valuation model, it requires explicit assumptions about the relationship between aggregate production in the economy and the amounts of

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25 For discussions of the effect of taxes on the appropriate measure of q, see George von Furstenberg, "Corporate Investment: Does Market Valuation Matter in the Aggregate?" *Brookings Papers on Economic Activity,* 2:1977, pp. 347-97; Lawrence H. Summers, "Taxation and Corporate Investment: A q-Theory Approach," *Brookings Papers on Economic Activity,* 1:1981, pp. 67-127; and Hayashi, "Tobin's Marginal q and Average q."

26 Von Furstenberg, "Corporate Investment: Does Market Valuation Matter in the Aggregate?" examines these and other measurement problems.

27 This approach, often called the neoclassicial model, is generally attributed to Dale W. Jorgenson. See, for example, his paper, "The Theory of Investment Behavior," in Robert Ferber, ed., *Determinants of Investment Behavior,* Columbia University Press, 1967, pp. 120-55.

28 If higher expected output implied higher earnings which, in turn, raise stock prices, the market-valuation model implicitly accounts for the effect of expected output. See Bosworth, "The Stock Market and the Economy," pp. 284-85, for a more detailed comparison of the two models.

capital and labor employed and about expected output. Regarding the financial cost of capital, it has been noted that the use of a weighted average of the cost of bond finance and equity finance to estimate the cost of financing is only appropriate if two conditions are satisfied. The risks of the new investments must be similar to the risks of the firm's existing capital stock and there must be no change in the firm's debt-equity ratio.

Empirical evidence

The empirical significance of stock price fluctuations on aggregate investment has not been resolved. Several early studies of business fixed investment found stock prices to be significant. Rather than estimating either of the models discussed here, however, these studies interpreted stock prices as a substitute for expected profits.[29]

More recent investigations of the empirical performance of the market-valuation model have generally found that fluctuations in q explain much of the variation in gross investment. One analyst estimated that, based on data from the 1953-68 period, a permanent 10 percent rise in the market value of firms would lead to about an 18 percent rise in equipment expenditures and about a 13 percent rise in structure expenditures by the end of ten quarters.[30] Another version of the market-valuation model, in which short-run stock price fluctuations are smoothed out and other economic variables are included, indicated that a 10 percent rise in stock prices would lead, in the long run, to an 8 percent rise in equipment expenditures and a 20 percent rise in structures expenditures.[31] A recent study that adjusted the market-valuation approach to take account of tax complications reported somewhat less response, with a 10 percent increase in stock prices leading to about a 7 percent increase in total gross investment.[32] Some researchers, on the other hand, have found little empirical support for the market-valuation model.[33]

The cost-of-capital model also has tracked investment spending reasonably well. As discussed below, this approach has been incorporated into a large-scale econometric model. An estimate of this model indicates that a 10 percent decline in the dividend-price ratio—due, say, to an increase in stock prices—would over time raise business investment in equipment about 1.6 percent and investment in structures about 3.5 percent.[34] With no change in dividends, a 10 percent decline in the dividend-price ratio corresponds to a 10

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29 Michael Evans reviews these studies in his *Macroeconomic Activity,* Harper and Row, 1969, pp. 108-12.

30 Charles W. Bischoff, "Business Investment in the 1970s: A Comparison of Models," *Brookings Papers on Economic Activity,* 1:1971, pp. 13-58. The investment elasticities of 1.8 and 1.3 reported in the text for equipment and structures with respect to stock prices were computed by the author from results reported in Bischoff's Table 3 plus data on the market value of firms reported by von Furstenberg, "Corporate Investment: Does Market Valuation Matter in the Aggregate?" The elasticity calculations are for 1971 data.

31 Robert Engle and Duncan Foley, "An Asset Price Model of Aggregate Investment," *International Economic Review,* October 1975, pp. 625-47.

32 Summers, "Taxation and Corporate Investment: A q-Theory Approach."

33 Von Furstenberg, "Corporate Investment: Does Market Valuation Matter in the Aggregate?" reported that a capacity utilization variable performed as well as q in investment equations and that the estimates of the market-valuation model exhibited serious statistical problems. A study updating the work of Bischoff found that stock price variables did not track the historical path of investment nearly as well as alternative models. See Peter K. Clark, "Investment in the 1970s: Theory, Performance, and Prediction," *Brookings Papers on Economy Activity,* 1:1979, pp. 73-113.

34 Bischoff, "Business Investment in the 1970s," Table 5. The elasticity estimates were computed using data for the fourth quarter of 1970.

percent rise in stock prices. Thus, the cost-of-capital model yields a smaller direct effect from stock price fluctuations. This result is not surprising since in the market-valuation models stock prices are the main explanatory variable while in the cost-of-capital models output fluctuations play a dominant role.[35] Studies that compare the forecasting records of the two models of investment have produced no consensus on which model is better.[36]

An estimate of the impact of the recent stock market rally

One way to estimate the impact of the recent stock market rally is by using an econometric model to simulate the likely time paths of the economy with and without the rise in stock prices. This section employs the FMP econometric model to perform such simulations.[37] Unlike most large-scale econometric models, the FMP model gives prominence to the stock market by including household net worth in the consumption equation and the financial cost of capital in the investment equation. This section briefly outlines how stock prices enter the model and then uses the model to estimate the aggregate impacts of the recent stock market rally.

Stock prices in the FMP model

The value of corporate equity is an endogenous variable in the FMP model so that stock market fluctuations are estimated rather than simply assumed to be exogenously given. The value of stock is estimated indirectly. First, total dividends are predicted largely on the basis of corporate profits. Second, the dividend-price ratio is estimated as a function mainly of the corporate bond rate and expected inflation. If the corporate bond rate rises, with expected inflation constant, the dividend-price ratio is expected to rise, reflecting the assumption that investors view stocks and bonds as substitutes. The total value of stocks is then calculated by dividing estimated dividends by the estimated dividend-price ratio.

Following the life-cycle model, consumption on nondurables and services is specified as depending on disposable real income and real wealth. Wealth is split into three categories: stocks, liquid assets, and real assets. It is assumed that stocks have less impact on consumption than the other two categories, since the coefficient on stocks is constrained to be only half that on the other two assets. The model predicts that an increase in the value of stock of, say $10 billion would lead to an increase in consumption of about $400 million with more than half the increase coming within two quarters. The model assumes, however, that wealth has no direct effect on the demand for consumer durables or housing.

Business investment in equipment and structures is modeled as a generalization of the cost-of-capital model discussed previously. The financial cost of capital for equipment is assumed to be a weighted average of the after-tax real interest rate on corporate bonds and the

35 This point was noted by Bosworth, "The Stock Market and the Economy."

36 Bischoff, "Business Investment in the 1970s," and Clark, "Investment in the 1970s," find that the cost-of-capital model does a better job in *ex post* forecasting while the opposite conclusion is reached by Engle and Foley, "An Asset Price Model." Neither model appeared dominant in a recent comparison by Richard W. Kopcke, "Forecasting Investment Spending: The Performance of Statistical Models," *New England Economic Review*, Federal Reserve Bank of Boston, November/December 1982, pp. 13-32.

37 FMP stands for Federal Reserve—M.I.T.—(University of) Pennsylvania representing the institutions sponsoring the model. An earlier version of the model is described in Frank De Leeuw and Edward Gramlich, "The Federal Reserve—MIT Econometric Model," *Federal Reserve Bulletin*, January 1968, pp. 11-40.

earnings-price ratio, which is approximated as twice the dividend-price ratio. The weights depend on the cost difference between the alternative financing methods, with the weight on equity rising when the dividend-price ratio falls. The financial cost of capital for structures differs somewhat, since a direct estimate of the earnings-price ratio is used and the weight on equity is constrained to be 0.7. Decreases in the cost of capital cause increases in the desired capital-output ratio, leading to higher levels of investment. Thus, if stock prices rise with no proportional change in dividends, investment spending is predicted to increase.

Impact of the recent stock market rally

To approximate the empirical significance of stock prices in the FMP model, two simulations were conducted with the model.[38] In both simulations, the actual values of policy variables and exogenous variables—the exchange rate, the price of oil, government expenditures, and the tax structure—were fed into the model for the first quarter of 1982 through the second quarter of 1983 and identical assumptions about these variables were made for the third quarter of 1983 through the first quarter of 1984. In particular, the federal funds interest rate was set at 9 percent over the period from the third quarter of 1983 through the first quarter of 1984. The difference between the two simulations is that in one the dividend-price ratio is fixed at its third quarter 1982 value of 6.1 from the fourth quarter of 1982 through the first quarter of 1984. In the other, though, the dividend-price ratio follows its actual downward path from the fourth quarter of 1982 to the second quarter of 1983 and is fixed thereafter at its second quarter 1983 value of 4.3. As a result, in the first simulation, the real value of common stocks was predicted to rise only $78.6 billion (1972 dollars) from the third quarter of 1982 to the first quarter of 1984. In the second simulation, the corresponding increase was $423 billion.

TABLE 1
Estimated effects of stock market rally within the FMP model
(Billions of 1972 dollars)

Time period	Difference In consumption	Difference In investment	Difference In GNP
1982:IV	+ 3.6	+ .6	+12.0
1983:I	+ 7.4	+ 3.5	+13.9
1983:II	+15.6	+ 7.1	+24.9
1983:III	+19.9	+11.7	+36.0
1983:IV	+24.3	+16.1	+45.4
1984:I	+27.4	+20.3	+53.7

Table 1 presents the results of the simulation exercise. Differences are shown between the estimated values of GNP, consumption, and business fixed investment, with and without a stock market rally. These estimates depend on the assumptions made about the federal funds rate and the permanent decline in the dividend-price ratio.[39] The model predicts that, as a result of the stock market rally, real GNP would be $53.7 billion (3.2 percent) higher by the first quarter of 1984. Consumption is estimated to be $27.4 billion (2.6 percent) higher and investment $20.3 billion (12 percent) higher, with the impact on investment appearing somewhat more slowly. The model also pre-

[38] Bosworth conducted a similar experiment using an antecedent of the FMP model to examine the impact of the stock price decline of 1973-74. See his "Stock Market and the Economy," pp. 289-90.

[39] Table 1 presents the differences between two sets of predictions rather than the differences between the actual values of the variables (known through the third quarter of 1983) and predictions that assume no rise in stock prices.

dicts that because of the stock market rally the unemployment rate would be 1.1 percentage points lower.

Thus, the FMP model indicates that, if maintained, the stock market rally should have substantial effects on the real economy. While these results depend on the particular assumptions about monetary and fiscal policy and on the absence of substantial shocks to the economy, they are consistent with the current recovery, which has followed the stock market rally. The results also suggest the recovery will continue in the absence of a stock market slump.

Summary and conclusions

The surge in stock prices which began in June 1982 has been followed by a strong economic recovery. There is considerable debate, however, on whether a systematic causal connection exists between stock prices and general economic conditions. This article has examined the past performance of stock prices as a leading indicator of business cycle turning points and reviewed the theoretical and empirical literature on the channels through which stock prices may influence the economy.

Stock price movements appear to be a valuable, but not infallible, leading indicator of business fluctuations in the United States. While occasionally giving false signals of economic downturns, stock prices since 1955 have always risen midway through an economic contraction. Thus, the recent stock market boom and subsequent economic recovery fit the historical pattern. Stock prices in other economies, on the other hand, have generally been poor guides to future economic developments.

The major effects of stock price changes are thought to be on the levels of household consumption and business investment spending. An increase in stock prices is believed to increase consumption through the resulting rise in household wealth. The way stock price changes affect investment is less clear. One view is that firms compare the price of new physical capital with the value the stock market places on such capital. Rising stock prices thus encourage firms to purchase new capital instead of acquiring existing capital through mergers. Another view sees stock price increases leading indirectly to a rise in real investment by lowering the cost of financing capital expansion.

The empirical evidence generally supports the theoretical roles of stock prices. Most studies have found a significant positive relationship between stock market movements and consumption, although the effect may be stretched over several periods. Similarly, most investigators have concluded that stock price increases lead to increases in investment in real capital but the size of the effect appears more uncertain.

A large econometric model of the United States in which stock prices influence consumption and investment was used to simulate the effects of the recent stock market rally on the economy. The model suggests that real output, consumption, and investment would be substantially less if stock prices had not risen since mid-1982.

Money Growth Volatility, Uncertainty, and High Interest Rates

By David W. Berson

It is widely known that interest rates have remained relatively high in the United States throughout the past few years. With the marked slowing in inflation, however, high nominal interest rates have meant real interest rates have been well above their historical averages. Although nominal rates have declined somewhat since mid-1982, they are nonetheless still high relative to inflation.

Analysts are agreed that high real interest rates have numerous adverse consequences. They hurt the economy in the short run by reducing interest-sensitive spending, causing reductions in production and employment. By slowing investment spending, they reduce economic growth in the longer run. This slower growth reduces incomes from levels that would have been reached otherwise, and slows gains in productivity, thereby putting upward pressure on prices.

Although there is general agreement that high real interest rates are bad for the economy, there is no general agreement about the causes of high interest rates. Traditional explanations cite restrictive Federal Reserve policy, prospects for large government budget deficits, and the slow adjustment in inflation expectations as the primary factors causing high interest rates.[1] In contrast, some analysts argue that much of the problem is due to the volatility of money growth. Their main contention is that the cause of the variation in money growth has been poor implementation of the Federal Reserve's monetary control procedures since they were changed in October 1979.[2] A common thread running through these arguments is that volatility in money growth has created uncertainty about the direction of Federal Reserve policy. Uncertainty, in turn, can affect interest rates in two ways. It can increase the demand

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[1] See, for example, Martin Feldstein, "Government Deficits and Aggregate Demand," *Journal of Monetary Economics,* January 1982, pp. 1-20; Charles Webster, "The Effects of Budget Deficits on Interest Rates," *Economic Review,* Federal Reserve Bank of Kansas City, May 1983; William DeWald, "Federal Deficits and Real Interest Rates: Theory and Evidence," *Economic Review,* Federal Reserve Bank of Atlanta, January 1983, pp. 20-29; and Lindley Clark, "Are Real Interest Rates Too High Or Too Low?" *The Wall Street Journal,* March 29, 1983.

[2] See, for example, articles on operating procedures by Allan Meltzer and Robert Rasche in the *Journal of Money, Credit, and Banking,* February 1982.

for money, which—in the absence of accommodative Federal Reserve policy—causes interest rates to rise. Or, it can raise inflationary expectations, which cause lenders to impose a premium on interest rates.[3]

This article examines the arguments that money growth volatility has been a major factor contributing to the recent high interest rates. The first section describes the conditions that made it necessary for the Federal Reserve to change its operating procedures. Results of the change are examined, and the rise in interest rates since the change is investigated. The second section discusses a standard model of interest rate determination in an economy without uncertainty. This model is then combined with a consensus model of the economy to show the pattern and magnitude of interest rate movements. The third section explores the effects of uncertainty in determining interest rates. Several possible relationships are investigated, and the theory proposed by Angelo Mascaro and Allan Meltzer is analyzed in depth. The results of their theory are compared with results obtained from other studies. The primary conclusion of this article is that the balance of evidence does not lend strong support to the view that money growth volatility has been a major factor contributing to high interest rates in recent years.

Recent history of high interest rates

The recent high interest rates in the United States had their precursors in the late 1970s. This section examines the rise in inflation and interest rates in the late 1970s and the Federal Reserve's response in changing its monetary control procedures. The changes are described, as are the effects of the changes, including the rise in real and nominal interest rates.

State of the economy in 1978-79

The U.S. economy expanded strongly in 1978 and early 1979, bringing sharp increases in inflation and nominal interest rates. Both had fallen sharply as a consequence of the 1973-75 recession, but as the expansion continued into its fourth year, the economy began to approach its full employment limits. Inflation, as measured by changes in the consumer price index, increased from 4.8 percent in 1976 to 13.0 percent in September 1979. Higher inflation contributed to a sustained rise in interest rates. For example, from 1976 to September 1979, the rate on 3-month Treasury bills rose from 5.0 percent to 10.2 percent, and the yield on 10-year constant maturity Treasury bonds increased from 7.6 percent to 9.3 percent.

Rising inflation contributed to a sharp fall in the value of the dollar in world currency markets. From the beginning of 1977 to September 1979, the value of the dollar fell more than 17 percent against other currencies on a trade-weighted basis. By increasing the price of foreign goods in U.S. markets, the decline in the dollar contributed to inflation in the United States.

Change in monetary control procedures

Against this backdrop of increasing inflation, rising interest rates, and a declining dollar, the Federal Reserve announced a change in its monetary control procedures on October 6, 1979. The Federal Reserve had been using the federal funds rate, the rate that banks pay other

[3] For a detailed exposition of these positions, see Angelo Mascaro and Allan Meltzer, "Long- and Short-Term Rates in a Risky World," mimeo, December 1982, and Angelo Mascaro and Allan Meltzer, "The Effects of Volatile Money Growth on Interest Rates and Economic Activity," reprinted in *The Congressional Record*, September 21, 1982, pp. S11932-S11934.

financial institutions for very short-term loans, as the operating variable for achieving its longer run objectives. The federal funds rate was set to keep the growth of money and credit within ranges that were believed consistent with the desired levels of production, employment, and inflation. For example, when the Federal Reserve wanted to slow an increase in money growth, it increased the federal funds rate by selling securities, which drained reserves from the banking system. With fewer reserves available to support lending, the federal funds rate would rise, tending to boost other short-term interest rates and so reduce money growth.

The change in operating procedures altered the way the Federal Reserve went about achieving its longer run objectives. Instead of using the federal funds rate as its operating variable and letting reserves adjust, the Federal Reserve established a path for nonborrowed reserves thought to be consistent with targets for growth of monetary and credit aggregates. Under the new operating procedures, the federal funds rate and other interest rates were allowed to adjust to whatever level was necessary to achieve the desired growth of money and credit.

The primary goal of the change in operating procedures was to improve control over the money stock and thereby improve the chances of lower inflation and inflation expectations.[4] Relying on the long-run relationship between monetary growth and inflation, the Federal Reserve planned a gradual reduction in the growth rates of the monetary aggregates to lower inflation. Also, inflationary expectations were expected to subside as markets saw the Federal Reserve slowing the growth of monetary aggregates.

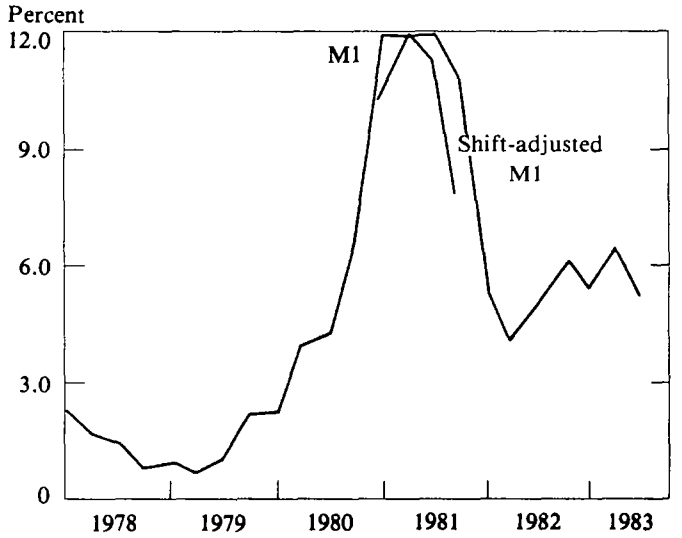
The change in procedures was expected to give the Federal Reserve more effective control over slowing the growth of monetary aggregates. By controlling nonborrowed reserves instead of the federal funds rate, the Federal Reserve believed it would be better able to meet its monetary growth targets. In turn, better control of the money stock would give the Federal Reserve more control in stabilizing economic activity when there were shocks to the economy resulting from changes in spending or shifts in inflation expectations. If, for example, spending were to increase rapidly—as it did in 1978 and 1979—holding to a money stock target would increase interest rates and tend to offset some of the increase in spending. This reduction in aggregate spending was expected to lower inflation. Also, the reduction in inflation brought about by the change in procedures was expected to strengthen the dollar. A lower inflation rate would make domestic goods more competitive in foreign markets, and a slower growth in aggregate spending would slow the growth of imports. Between these two effects, the value of the dollar would rise in world currency markets.

These goals appear to have been met, given the experience of the past four years. The growth of the monetary aggregates slowed appreciably until well into 1982, and inflation slowed dramatically. Growth of M1, the narrowest of the money stock measures and the one used to measure transactions balances, slowed from 7.4 percent in 1979 to 5.1 percent in 1981. This slowing continued in 1982, as the M1 measure of the money stock grew at an annual rate of only 5.4 percent through July.[5] In-

[4] For a complete discussion of the goals of the change in operating procedures, see Federal Reserve Staff Study, *New Monetary Control Procedures,* Vols. 1 and 2, Board of Governors of the Federal Reserve System, February 1981.

[5] These growth rates are fourth quarter to fourth quarter measures of shift-unadjusted, seasonally adjusted M1. Using a shift-adjusted measure of M1-B, which takes account of the impact of structural changes on M1 of the extension of NOW accounts nationwide, the fall in growth rates is

CHART 1
Variability of M1 Growth
(1977:IV-1983:II)



Note: Variability of M1 growth is measured as a four-quarter moving average of changes in M1 growth rates.

flation, as measured by the CPI, fell from 13.3 percent in 1979 to only 3.9 percent in 1982 and has remained low so far in 1983. As expected, lower inflation has been accompanied by strengthening of the foreign exchange value of the U.S. dollar.

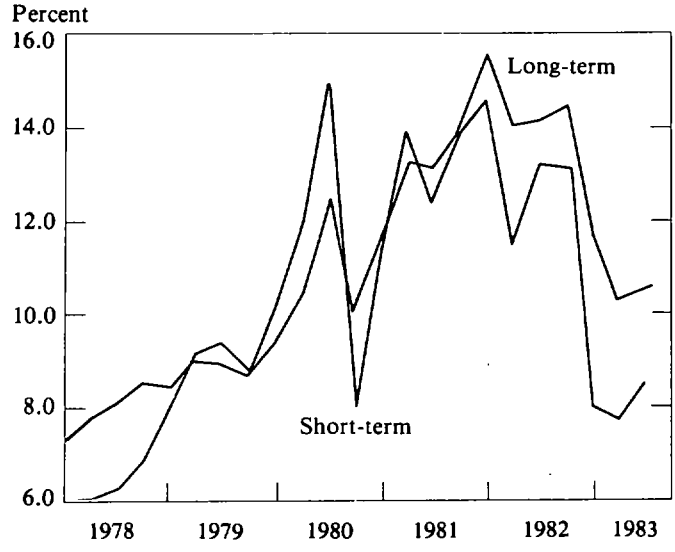
While these improvements were welcomed, some of the developments after the change in monetary control procedures were not. One was the increase in the variability of interest rates; another was the greater variability of monetary growth; and a third was the very high level of interest rates that has prevailed for much of the last four years. It was expected that interest rates would swing more when nonborrowed reserve growth rather than the federal funds rate was used as the operating variable for achieving monetary growth objectives. Under the new procedures, for example, with the Federal Reserve no longer increasing nonborrowed reserves when the demand for money increased, interest rates would rise to equilibrate the demand for money with its supply. The expected result that followed directly from the policy change, therefore, was wider swings in interest rates.

It had not been expected, however, that growth of the money stock would vary more than under the previous procedure. The belief was that by using a nonborrowed reserve aggregate operating variable, the Federal Reserve would be able to achieve smoother growth in the money stock. As Chart 1 shows, this has not been the case.[6] Variability in money growth

even more dramatic—from 7.4 percent in 1979 to 2.3 percent in 1981, a decline of 69 percent. Through July 1982, the annualized growth rate was a negative 0.3 percent.

6 Variability in this case is defined to equal $[(\Delta M1G^2_{-1} + \Delta M1G^2_{-2} + \Delta M1G^2_{-3} + \Delta M1G^2_{-4})/4]^{1/2}$, where $\Delta M1G$ is the change in the growth rate of M1. It is

CHART 2
Nominal Interest Rates
(1977:IV-1983:I)



began increasing almost immediately after the change in procedures was announced. Critics have cited this increase in the volatility of money growth as evidence that the Federal Reserve has not operated well under the new procedures. This volatility subsided after the first year of the new operating procedures, but remained higher than before the change.

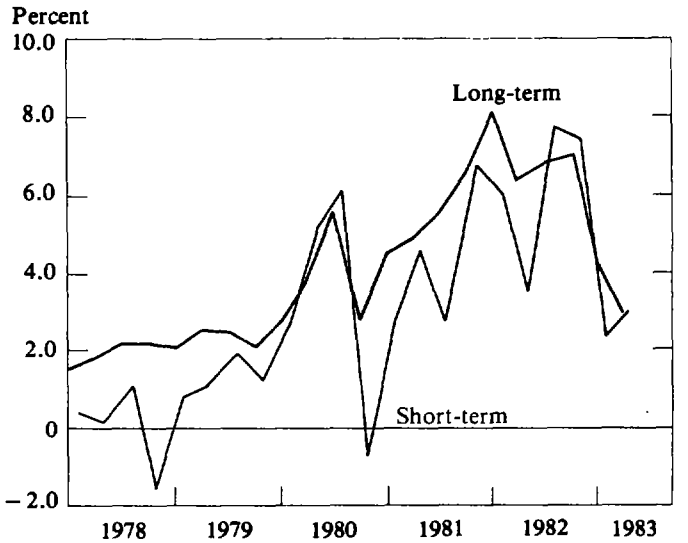
From the standpoint of monetary policy, the most important development since the change in operating procedures has been the sharp rise of interest rates. Chart 2 shows nominal interest rates on 3-month and 10-year Treasury securities since 1978. Although nominal interest rates were high in 1978 and 1979, they rose sharply after the monetary control procedures were changed. Not until mid-1982, when the severity of the recession reduced borrowing demands and the Federal Reserve pursued a less restrictive reserves policy, did interest rates show a sustained decline.

Real interest rates also were high over much of this period.[7] The real rate of interest is the actual rate charged for borrowing or lending

similar to the measure of variability used by Mascaro and Meltzer, although they deal with unexpected portions of the money stock.

[7] In practice, there is no one correct way to measure real rates. With tax effects ignored, they should be measured by the nominal rate less the **expected** rate of inflation over the life of the investment. The difficulty with this definition is that there is no agreement on how to determine the expected inflation rate. Given this difficulty, this article uses as the real rate the actual nominal rate minus the average of an inflation forecast. The models used in forecasting come from a moving ARIMA estimation. See Douglas Pearce, "Comparing Survey and Rational Measures of Expected Inflation: Forecast Performance and Interest Rates," *Journal of Money, Credit, and Banking,* November 1979, pp. 447-56. For a quarterly model, the expected rate of inflation for 3-month Treasury bills is simply the one-quarter-ahead forecast. For 10-year constant maturity Treasury bonds, the measure is the mean of the 10-year forecast.

CHART 3
Real Interest Rates
(1977:IV-1983:I)



less the expected rate of inflation over the term of the debt instrument. It measures the return from lending, or the cost of borrowing, in terms of the purchasing power of the loan amount. From 1958 through 1979, the real rate on 3-month Treasury bills averaged only 0.6 percent, and the real return on 10-year constant maturity Treasury bonds averaged 1.9 percent.[8] In 1981, however, long-term real rates rose to an average of 6.3 percent, and short-term real rates, to 4.8 percent. (See Chart 3.)

Inadequacy of standard models in explaining high interest rates

Standard models of the economy have proven inadequate in explaining the high level of interest rates in recent years. The slowing of monetary growth after October 1979 would be expected to lead to a temporary increase in interest rates. However, empirical estimates of standard models have not explained the magnitude or duration of higher interest rates.

A model of interest rate determination

Short-term interest rates are determined in standard economic models by the interaction of the demand for and supply of money. Thus, it is necessary to analyze equilibrium conditions in the money market to understand why slower money growth leads to a temporary rise in interest rates.

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[8] These figures are the averages over the corresponding periods of quarterly data. The quarterly figures were determined by using the beginning of quarter nominal rate rather than averages of rates. Using averaged rates can give misleading results. See Frederic Mishkin, "Monetary Policy and Long-Term Interest Rates," *Journal of Monetary Economics,* January 1981, pp. 29-55.

The demand for money depends primarily on income and interest rates. One of the main uses for money is to pay for goods and services.[9] As income rises, the size and number of transactions tend to increase, creating a positive relationship between income and the demand for money. There is an opportunity cost, however, in holding money for transactions. This cost is the interest that has to be foregone for not holding those money balances in higher yielding assets. As this cost increases with a rise in the overall level of interest rates, the demand for money tends to decline as interest rates rise.

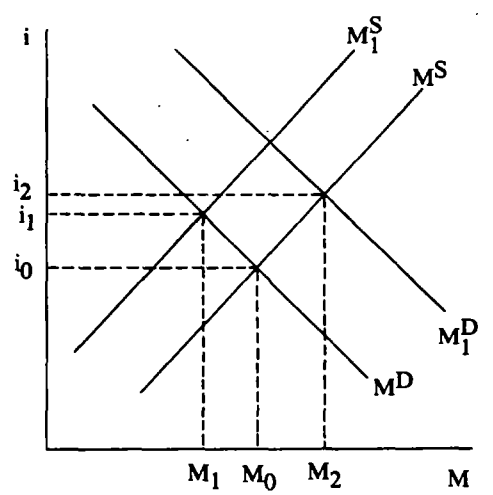
The supply of money depends on several factors, some of which the Federal Reserve cannot control. Through its use of the discount rate, required reserve ratios, and open market operations that affect the amount of nonborrowed reserves in the banking system, the Federal Reserve has partial control of the money supply. These instruments of monetary policy are not enough, however, to control the money supply completely. How depository institutions and the general public behave determines to what extent these instruments affect the supply of money.

Since the behavior of the public and financial institutions cannot be controlled, the money stock can vary unpredictably in the short run. For example, banks might decide to hold more excess reserves, thereby reducing the amount of reserves available to expand the money supply. Moreover, since an increase in market interest rates, given the level of the discount rate, increases the incentive of banks to borrow at the discount window, financial institutions will have increased reserves causing the supply of money to be positively related to the interest rate. Thus, the Federal Reserve influences but cannot completely control the behavior of depository institutions in expanding or contracting the supply of money.

The money stock and interest rate are determined through the interaction of money demand and money supply. In Figure 1, the supply of money is represented by M^S and the demand for money is represented by M^D. Given these relations, only if the interest rate is i_0 will the amount of money demanded equal the amount of money supplied. Only at that point is the money market in equilbrium.

A reduction in nonborrowed reserves in the banking system brought about by an open market sale of securities by the Federal Reserve reduces the supply of money and increases interest rates. If the public and the banking system continued to behave as before, a reduction in nonborrowed reserves would shift the

FIGURE 1
Determination of the equilibrium interest rate and money stock



[9] For a detailed description of this explanation of the demand for money, see William Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," *Quarterly Journal of Economics*, November 1952, pp. 545-56; and James Tobin, "The Interest-Elasticity of Transactions Demand for Cash," *Review of Economics and Statistics*, August 1956, pp. 241-47. There are other ways to derive the demand for money, but this is sufficient to show an interest elasticity.

money supply function to M_1^S, causing an increase in interest rates and a decrease in the money stock. A comparable shift in the money supply function could also result, however from changes in banking system behavior. If banks decided to increase their holdings of excess reserves, the money supply function would decline, producing a similar fall in the money stock and a rise in interest rates, all without any action by the Federal Reserve.

Changes in the money demand function would also affect interest rates and the money stock, without action by the Federal Reserve. For example, an increase in income or in the public's preference for money relative to other assets would result in a shifting of the money demand function to M_1^D. In the absence of any additional behavioral changes or Federal Reserve policy actions, this causes an increase in both interest and the money stock.

A model of the economy and recent interest rate movements

The model of interest rate determination presented above can be combined with a model of the overall economy to describe the movements in interest rates, production, and prices since 1979. One reason for the change in monetary control procedures was to enhance the likelihood of reducing the growth rate of the money stock and thereby to reduce both actual and expected inflation. Within a standard model, therefore, analysis of the high level of interest rates since 1979 focuses on the Federal Reserve policy decision to strengthen procedures for slowing the growth rate of the money stock.

The Federal Reserve can slow growth of the money stock by slowing the growth of nonborrowed reserves available to the banking system. In the absence of any offsetting behavioral responses, a reduction in nonborrowed reserves reduces the supply of money and, given the short-run level of money demand, raises both nominal and real interest rates. Since financial markets clear almost instantly, nominal rates rise quickly. This initial rise in interest rates is only slightly impeded by a reduction in the quantity of money demanded, since money demand is not very sensitive to interest rates in the short run. Many analysts believe that inflation expectations change slowly so that real interest rates rise initially by the same amount as nominal rates. This increase in real rates increases the real cost of borrowing and, thus, lowers spending on business investment, consumer durables, and housing. These spending reductions happen over time, however, because of contractual obligations and other factors that cause a lag between changes in interest rates and changes in spending decisions. As spending is gradually reduced, income and money demand decline. The reduction in money demand lowers short-term interest rates from the high levels caused by the initial Federal Reserve policy actions.[10]

Long-term interest rates also fall from their temporarily higher levels, though they fall more slowly. As aggregate spending is reduced, price increases are also reduced, eventually lowering inflationary expectations. With less expected inflation, the interest rate on long-term securities is lowered because a lower inflation premium is believed necessary to protect the real value of the securities. How quickly real rates return to normal depends on the relative speeds of adjustment of inflation expectations and changes in money demand. The important point, however, is that monetary restraint

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[10] For more detailed descriptions of this overshooting process, see J. Harold McClure, "Whiplash Effects in New Classical and Neo-Classical Models: Two Monetary Explanations of the Recent Ups and Downs of Interest Rates," mimeo, Claremont Graduate School, November 1982, and Ronald Teigen, "A Critical Look at Monetarist Economics," *Review*, Federal Reserve Bank of St. Louis, January 1972, pp. 10-25.

causes an overshooting of both short and long-term interest rates for some period before full adjustment occurs.

This behavioral model gives a consistent explanation for the general pattern of interest rate movements since 1979. The sharp increase in interest rates in 1980 and 1981 and the subsequent decline since mid-1982 form precisely the kind of overshooting pattern of interest rate movements the model implies would occur in response to restrictive policy actions intended to reduce monetary growth. An important question, however, is whether the model can explain the magnitude and duration of the higher interest rates.

The biggest increases in interest rates were in 1981 and early 1982, when growth of the money stock was only slightly less than in 1980. Also, the actual rate of inflation and expectations of future inflation fell rapidly over this period.[11] It seems unlikely, according to this model, that interest rates would rise sharply and remain high when growth in the money stock was declining slowly and inflation expectations were falling fairly quickly. Indeed, predictions of interest rate levels from mainstream econometric models were uniformly too low. For example, one large forecasting firm projected the interest rate on 3-month Treasury bills at 8.0 percent for 1980 and 11.4 percent for 1981. The actual annual interest rates were 11.5 percent for 1980 and 14.1 percent for 1981.[12]

Two other explanations have been offered for the magnitude and duration of the increase in interest rates over that period. One such explanation is that high federal budget deficits, both actual and prospective, pushed interest rates up. The idea that budget deficits tend to raise interest rates is conceptually appealing, but there is little empirical evidence that they actually have a significant effect on interest rates.[13] A second possible explanation is that inflation expectations did not fall as a result of the recession and may, in fact, have risen because of the 1979 oil supply shock. As noted above, however, the evidence shows a lessening of inflation expectations over much of this period. Thus, neither of these additional explanations seems to account adequately for interest rate increases after 1979. Another explanation is needed for the persistently high level of interest rates since 1979.

Uncertainty and interest rates

Some analysts attribute the persistence of high interest rates since 1979 to the increase in money growth variability after the change in Federal Reserve operating procedures. As noted above, neither the increased variability of money growth nor the unprecedented increase in interest rates had been anticipated to result from adoption of a reserve aggregate operating procedure to slow monetary growth. The simultaneous occurrence of these two developments, which cannot be adequately explained within a standard model of the economy, led some to wonder whether increas-

11 See *The Decision-Makers Poll,* A. G. Becker Paribas, July 7, 1983, pp. 2-4. There is evidence, however, that the fall in money stock growth was actually greater than the M1 figures would imply. A shift-adjusted measure of M1, which takes account of the shift in asset holdings in 1981, shows the fall in money stock growth as much more pronounced. By this measure, money growth, which has fallen to 6.6 percent in 1980, fell to only 3.4 percent in 1981. It is difficult to determine what the appropriate measure of money as a transactions balance was for the 1980-82 period, given the new monetary accounts introduced and the shifting of assets between them. It is still unlikely, however, that the fall in money growth accounts for all the increase in interest rates over that period.

12 These figures are taken from the March 1979 and March 1980 Wharton Quarterly Econometric Model, Baseline Forecasts.

13 Webster, pp. 25-28.

ed money growth variability might not somehow have caused the higher interest rates.

Uncertainty could provide a link between money growth variability and the level of interest rates. Interest rates can be thought of as the reward for postponing consumption or, equivalently, as the price of investing to increase future income. Viewed in this way, uncertainty about the future might reasonably be expected to raise interest rates. To the extent that increased variability in money growth leads to greater uncertainty, therefore, that variability could contribute to higher interest rates.

This section analyzes the ways that uncertainty might affect interest rates. A model suggesting that Federal Reserve policy actions are the primary cause of uncertainty—and, therefore, higher interest rates than necessary—is examined. Shortcomings of this model as an explanation for high interest rates since 1979 also are analyzed. Finally, results of other studies of the effects of uncertainty on interest rates are examined.

Why does uncertainty affect interest rates?

John Maynard Keynes hypothesized that people hold wealth in the form of money beyond what is needed for transactions because they are uncertain about future interest rates.[14] He divided the demand for money into transactions, speculative, and precautionary demand. Transactions demand is simply the need for cash to carry out current transactions. Since transactions increase with income, this demand depends positively on income. Speculative demand pertains to money held as an asset instead of securities because of an expectation of capital losses if securities are held. If there is an expectation of future interest rate increases, holders of securities will attempt to shift their asset holdings from bonds to money to avoid the expected capital losses. Thus, demand depends inversely on the interest rate. Precautionary demand is for funds to use in an emergency, to take advantage of unforeseen opportunities, or to use against future money-valued liabilities. This demand could not be met easily by holding securities. Securities could lose some of their value, and often they are not instantly convertible into money for transactions purposes.

Both the speculative and precautionary demands depend on uncertainty. An increase in uncertainty increases money holdings for speculative purposes, because future securities prices become more difficult to forecast and the risk of capital losses becomes greater. It increases the precautionary demand because more unforeseen emergencies and opportunities could arise.[15] As shown in Figure 1, such an increase in money demand increases interest rates unless offset by a commensurate increase in money supply.

Milton Friedman and Anna J. Schwartz addressed the issue of uncertainty and the demand for money by hypothesizing that people hold more of their assets in the form of money when

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14 John Maynard Keynes, *The General Theory of Employment, Interest, and Money,* London: Macmillan, 1936, pp. 166-72 and 194-209.

15 Tobin extended this analysis of the effect of uncertainty on the demand for money and made explicit the increase in money demand that results from an increase in uncertainty. In his model, people are assumed to be trying to maximize their well-being, which depends on the return from their assets and the riskiness of the assets. He assumed that the additional benefits of wealth decline as wealth increases and that people are risk averse. Given these assumptions, Tobin showed that an increase in risk, as measured by the spread on prospective asset yields, increases the demand for money, which tends to increase interest rates. See James Tobin, "Liquidity Preference as a Behavior Towards Risk," *The Review of Economic Studies,* February 1958, pp. 65-86.

conditions are uncertain than when they expect economic conditions to be stable.[16] This behavior, they figured, is because of the versatility of money, which provides flexibility in meeting emergencies and taking advantage of opportunities. The greater the uncertainty about the future, the greater the benefit of flexibility and the greater the demand for money. As a result, if there is no change in the money supply, interest rates rise when conditions become more uncertain. Friedman and Schwartz concluded that the postwar trend of lower demand for money—and the corresponding upward trend in the velocity of money—was due largely to the stability of postwar economic conditions.

Other studies have considered the effect of uncertainty on both sides of the market for loanable funds.[17] On the lending (supply) side of the market, since an increase in uncertainty about expected inflation implies additional uncertainty about the real return from lending, risk averse investors will increase the nominal interest rate by more than the increase in expected inflation. On the borrowing (demand) side, increased uncertainty about expected inflation means a reduction in investment spending. This reduction in expenditures reduces the demand for money and, so, tends to lower interest rates. These studies criticize others that fail to separate the two effects and estimate only the risk premium on interest rates.

16 Milton Friedman and Anna J. Schwartz, *A Monetary History of the United States: 1867-1960,* Princeton University Press for the National Bureau of Economic Research, 1963, pp. 672-75.

17 Maurice D. Levi and John H. Makin, "Fisher, Phillips, Friedman and the Measured Impact of Inflation on Interest," *The Journal of Finance,* March 1979, pp. 35-52; and John H. Makin, "Real Interest, Money Surprises, Anticipated Inflation, and Fiscal Deficits," mimeo, University of Washington and National Bureau of Economic Research, June 1982.

Money growth volatility models

Mascaro and Meltzer present evidence in two recent studies that uncertainty has increased interest rates since 1979.[18] Building on the theories of Keynes and Friedman and Schwartz, they hypothesize that an increase in uncertainty increases the demand for money. The increase in money demand tends, in turn, to increase interest rates, as individuals shift from real capital to money and short-term securities. The shift out of real assets unambiguously raises long-term interest rates, since as the demand for long-term debt instruments falls, the price of long-term debt falls and its yield increases. The effect on short-term interest rates in their model is theoretically ambiguous, however. The increase in the demand for money tends to raise short-term rates, while the increase in the demand for short-term securities tends to lower them. Mascaro and Meltzer find, however, that their model gives an empirical result of an increase in short-term interest rates as a result of uncertainty.[19]

Variability in income can result from variability in any of several factors. Nominal income is equal to the product of the money stock and the velocity of money, which is defined as the ratio of income to the money stock. Using this relationship, Mascaro and Meltzer

18 See references in footnote 3.

19 They distinguish between three causes of uncertainty. First, the rate of inflation may be incorrectly forecast, with the result that the real value of assets may not be correctly anticipated and a less than optimal allocation be made between real and nominal assets. Second, changes in regulatory rules and laws, or the formation of cartels, may affect the growth of output and, thus, the expected return from real capital. Third, monetary policy, if improperly used, may increase the effects of real shocks—and, therefore, uncertainty—even if it is used in an attempt to reduce fluctuations in economic activity resulting from the shocks. If these are the only sources of instability in the economy, their sum is the variability of nominal national income.

argue that uncertainty regarding nominal income growth must result either from uncertainty about money growth or uncertainty about velocity.[20] They further argue that uncertainty about money growth is due to unexpected changes in monetary policy or slippages in monetary control procedures. Lenders are compensated for increased uncertainty by the addition of a risk premium to the interest rate they charge. The greater the uncertainty about money growth, the more difficult it is for market participants to distinguish between large transitory control errors and unannounced changes in planned money growth. The results are interest rates that are higher than they would be otherwise.

In their empirical results, Mascaro and Meltzer find that both money growth volatility and velocity volatility add a significant risk premium to nominal interest rates. They find, however, that the effect of money growth volatility is much greater. Over the 1969-82 period, they find velocity volatility added a risk premium of up to almost 1-1/2 percentage points, with the highest premium after 1979. They estimate that a reduction of about a half percentage point in long-term rates is the most that could reasonably be expected from reductions in velocity volatility. In contrast, they find money growth volatility added a risk premium of 4 to 6 percentage points over the same period, again with the highest premium after 1979. According to their empirical estimates, reduction in money growth variability to the average level of the 1977-79 period would reduce long-term rates 2 to 3 percentage points. Thus, Mascaro and Meltzer conclude that money growth volatility has been a major factor contributing to the high interest rates since 1979. Moreover, since they assume that money growth is largely controlled by the Federal Reserve, they argue that changes in Federal Reserve operating procedures to smooth this growth would result in a decline in interest rates.

The model that Mascaro and Meltzer use implies that money growth volatility increases both short and long-term interest rates. Milton Friedman argues, however, that variability of money growth affects only short-term rates.[21] He finds some correlation between money growth variability and fluctuations in short-term interest rates and possibly between money growth variability and high short-term rates. However, he explains the level of long-term rates as the sum of a real return and an expected inflation rate, without being affected by variability of money growth. Expected inflation is the mean of a low and a high inflation scenario. Low inflation would occur if federal expenditures are reduced and the Federal Reserve maintains moderate money growth. High inflation would occur if both federal expenditures and money growth increased at rates comparable to those in past recoveries. Since market participants are uncertain which result will occur, they form an implicit weighting of the two possibilities. Friedman simply assigns a weight of one-half to each of the two.

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[20] Since, by definition, $Y = M \cdot V$, where Y equals nominal national income, M equals the nominal money stock, and V equals the income velocity of money, $y = m + v$ can be written with lower case letters to indicate growth rates. The variability of national income growth is then var y = var m + var v + 2 covar (m,v), where var is the variance and covar is the covariance. If the covariance between m and v is assumed to be zero, total variations in the level of output are due to changes in money growth and changes in money demand growth (velocity growth). Changes in money demand growth theoretically pick up all of the changes in the economy other than money stock growth. Mascaro and Meltzer later relax the assumption that the corvariance is zero and find it does not change their results.

[21] See, for example, Milton Friedman, "Interest Rates and the Budget," *Newsweek*, June 28, 1982, p. 70; and "The Yo-Yo Economy," *Newsweek*, February 15, 1982, p. 72.

Shortcomings of the money growth volatility models

These studies of money growth volatility have several shortcomings, the most basic being the assumption by both Friedman and by Mascaro and Meltzer that all volatility in the money stock is caused by Federal Reserve actions. As demonstrated in Figure 1, the money stock is jointly determined by the supply of and demand for money, which depends in part on the actions of depository institutions and on the asset preferences of households and firms. If changes in the money stock do cause uncertainty, money stock volatility may be the correct measure of that uncertainty. However, changes in the money stock should not be interpreted as being caused solely by the Federal Reserve, especially when no evidence is presented that money supply rather than money demand factors are responsible for those changes.

Another shortcoming of these models occurs, in the Mascaro and Meltzer studies, with the use of velocity volatility to represent all uncertainty other than that caused by money growth. The problem arises because the causality between velocity and interest rates may run strongly from interest rates to velocity, the opposite of what Mascaro and Meltzer assumed. An increase in interest rates causes people to economize on money balances and increase their demand for other financial and real assets. The reduction in money balances leads to an increase in velocity as money demand falls relative to GNP.

An additional problem with the velocity volatility term is the high correlation between it and the money growth volatility term in some situations. For example, a sudden change in asset preferences by the public would cause unexpected changes in both money growth and velocity. It becomes difficult in this case to interpret what the coefficients on these two terms imply about their effect on interest rates, since both reflect the same underlying behavior. For these reasons, it is difficult to interpret the significance of an observed relationship between interest rates and velocity in a simple model of the type used by Mascaro and Meltzer. A more complete model that includes policy variables affecting the position of the money supply curve, such as nonborrowed reserves and the discount rate, would be required to allow distinction between money demand and money supply disturbances. Omitting these policy variables biases the results toward attributing uncertainty primarily to unanticipated actions by the Federal Reserve.

A third shortcoming of these money growth volatility models is their failure to account for special factors that may have affected the variability of money growth since 1979. Mascaro and Meltzer recognize that much of the increase in variability of money growth since 1979 is due to the imposition and removal of credit controls. As Chart 1 shows, much of the increase in volatility can be accounted for by the period of credit controls. Neither they nor Friedman, however, make an attempt to adjust the variability of money growth for those events, which cannot be called Federal Reserve policy actions in the usual sense. They also do not take into account difficulties in seasonal adjustment of recent money stock data. Seasonal adjustment procedures do not allow immediate adjustment for changing seasonal patterns. Reestimation of seasonal factors in subsequent years often tends to smooth variability. The Federal Reserve has estimated that incomplete seasonal adjustments accounted for most of the measured increase in money growth volatility from October 1979 to October 1980.[22] Thus, much of the variability

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22 Federal Reserve Staff Study, Vol. 1, pp. A5-A7. An experimental seasonal adjustment procedure for M1

of M1 as measured in Chart 1 is accounted for by incomplete seasonal adjustment.

Nor do Mascaro and Meltzer or Friedman consider the effects of changing asset preferences by the nonbank public. The period since the change in monetary control procedures has been marked by financial innovation and deregulation resulting in new accounts and cash management techniques being developed. These changes caused shifts between the types of assets the public wants to hold, which also caused movements into and out of the money stock. A shift-adjusted measure of the money stock was developed for 1981 in an effort to account for the introduction of nationwide NOW accounts. Use of this measure of the money stock reduces somewhat the volatility of money growth at the beginning of this period, although volatility still increased after the change in monetary control procedures. (See Chart 1.)

The fourth shortcoming in these models is the assumption they make that uncertainty is caused primarily by money growth volatility. A Federal Reserve study showed that during the year following the change in procedures, the correlation between fluctuations in short-term interest rates and the levels of the rates was greater than the correlation between fluctuations in the unexpected portion of the money stock and the level of short-term rates.[23] This correlation was updated for this article, and the result remains the same. During the period from the change in procedures to early 1983, the correlation coefficient between the variability in the growth rate of the money stock and the interest rate on 3-month Treasury bills is 0.39, while the correlation between variability in that interest rate and its level is 0.69. This, of course, does not prove that one or the other volatility measure causes interest rates to be higher than they would be otherwise. It seems plausible, however, that risk premiums in interest rates should be related to fluctuations in those rates and, therefore, uncertainty about those rates. This connection is important because most economists believe that tighter control of the money stock results in greater variability of interest rates.[24] If reducing the variability of money growth tends to increase the variability of interest rates—and if this increase in interest rate variability causes increased uncertainty about future rates and thus causes risk premiums to be imposed—the final result of increased monetary control could be an increase in interest rates.

Results of other studies

Several studies have found evidence that uncertainty lowers interest rates and that uncertainty did not increase after the change in

developed by the Board staff which is potentially more accurate than the current procedure shows that although volatility increased over this period, the magnitude of the increase is not as great as when measured using the current seasonal adjustment procedure. Using the current seasonal adjustment procedure, the standard deviation of monthly M1 growth was 4.8 in 1979, rising to 11.1 in 1980, and then falling to 9.2 in 1981 and 8.6 through September 1982. The experimental seasonal adjustment procedure found that the standard deviation of M1 growth rose to only 10.3 in 1980 and fell to 8.8 in 1981 and 7.0 through September 1982. See David A. Pierce, Michael R. Grupe, and William P. Cleveland, "Seasonal Adjustment of the Weekly Monetary Aggregates: A Model-based Approach," Federal Reserve Staff Study, No. 125. These figures use money stock figures and seasonal adjustment factors current as of October 1982. In addition, Mascaro and Meltzer do not consider the volatility of broader monetary aggregates. For example, the volatility of M2 was not significantly greater after the change in procedures (from 1980 to the first quarter of 1983) than it was in the period immediately preceding the change (1978 and 1979).

23 See "Volcker Responds to Treasury Study," *The Congressional Record,* Senate, September 21, 1982, p. S11932.

24 See William Poole, "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model," *Quarterly Journal of Economics,* May 1970, pp. 197-216.

monetary control procedures. These results clearly differ from the results Mascaro and Meltzer obtained.

Two studies by Levi and Makin of both the supply and demand sides of the loanable funds market have found demand had a relatively larger impact on interest rates than supply.[25] The net effect, according to these studies, is that uncertainty lowers interest rates because uncertainty reduces interest-sensitive expenditures on the demand side by more than the increase in risk premiums demanded by the suppliers of funds.

A study by Fieleke on international comparisons of the correlation between variability of money growth and levels of interest rates did not provide strong evidence of such a linkage.[26] This study looked, in part, at fluctuations in economic activity and money growth and at the level of interest rates in the seven large western industrialized nations from 1970 to 1980. It found very little relationship between the stability of money growth and the level of long-term interest rates. In fact, Japan, the country with the most unstable money growth over this period, had the lowest average interest rates.

Another study by Smirlock looked at the relationship between the demand for money and inflation uncertainty.[27] Use of standard money demand equations showed a significant negative effect of inflation uncertainty on money demand. This result is explained by the possibility of higher opportunity costs of holding money if inflation increased. Thus, this empirical study contradicts the theoretical findings of Keynes and of Friedman and Schwartz, which hypothesized a positive relationship between uncertainty and money demand. If the negative relationship found in this study is correct, then, to the extent that uncertainty is reduced by smoothing of money growth by the Federal Reserve, interest rates would rise through an increased demand for money.

One way to determine if uncertainty has increased is to determine if a liquidity premium has been added to long-term rates. This premium would be expected if increased uncertainty about future interest rates made estimates of debt yields less precise. The greater the uncertainty, the greater the difficulty of forecasting. To induce individuals to hold long-term debt, a liquidity premium would have to be paid to the holders of this debt to induce them to sacrifice the liquidity of money or short-term debt. The results, then, would be an increase in long-term rates relative to short-term rates. Under these circumstances, market participants might expect the new monetary control procedures to increase the risk of capital losses on long-term securities by making interest rates more variable.

The staff of the Board of Governors investigated this possibility after the first year of the control changes and found no evidence of liquidity premiums having increased.[28] By this measure, it appears that uncertainty did not increase as a direct result of the change in monetary control procedures, even though money growth became more volatile.

Conclusion

This article has investigated the high interest rates since the change in Federal Reserve monetary control procedures in October 1979. As stated, the change in monetary control pro-

25 Levi and Makin,and Makin.

26 Norman Fieleke, "Fluctuations in Economic Activity and the Money Supply: An Overview," *New England Economic Review,* May/June 1982, pp. 5-14.

27 Michael Smirlock, "Inflation Uncertainty and the Demand for Money," *Economic Inquiry,* July 1982, pp. 355-63.

28 *New Monetary Control Procedures,* p. A11.

cedures arose as a response to increasing inflation rates and a declining dollar. The slowing of inflation and the increase in the value of the dollar were two of the expected results of the change, but some of the developments which also occurred were unexpected. Money growth became much more variable after the change in operating procedures, and interest rates went to levels higher than most analysts expected—and remained at these high levels for some time. Some analysts have claimed that increased variability of the money stock caused by the change in procedures has been a primary cause of the high rates because of an increase in uncertainty which resulted when money growth became more variable.

This article shows that the idea of uncertainty increasing the demand for money had its precursors in the works of Keynes and of Friedman and Schwartz. Mascaro and Meltzer combined this idea with the assumption that Federal Reserve actions have caused an increase in uncertainty since 1979. Their empirical estimates suggest that volatility in money growth resulting from inadequate monetary control procedures has contributed significantly to high interest rates in recent years.

The shortcomings in the methodology used by Mascaro and Meltzer cast doubt on the validity of their finding, however. Contrary to their assumption, the Federal Reserve does not have complete control of the money stock, at least in the short run, since the money stock responds to changes in both the demand for money and the behavior of the public and the banking system. Mascaro and Meltzer also failed to account for special factors that have affected the variability of money growth, such as inherent difficulties in seasonal adjustment, changing asset preferences of the public, and the imposition and removal of credit controls. Velocity volatility as a measure of changes in nonmoney demand affecting interest rates is shown to have been a poor measure. Moreover, the level of interest rates is more closely correlated with variability of interest rates than with variability of money growth. Thus, reducing money growth variability, as Mascaro and Meltzer recommend, might actually increase interest rate variability and, therefore, the level of interest rates.

This article did not find a convincing explanation for the magnitude of recent interest rate changes in either a standard model of interest rates or in the money growth volatility studies of Mascaro and Meltzer. Despite the shortcomings suffered by their models, as well as the evidence from other studies, there remains a line of theory which supports the idea that money growth volatility increases interest rates. However, in order to properly test the proposition that money growth volatility has been a significant cause of high interest rates, it will be necessary to eliminate the problems in the Mascaro and Meltzer studies.

Other explanations for the levels of high interest rates may be found in the decontrol and innovation in financial markets which occurred in recent years. The removal of interest rate ceilings on loans may have changed the responsiveness of borrowing and spending to interest rates. Instead of high rates leading to a "credit crunch" in which lending activity was brought to a halt, high rates may simply reduce the quantity of loans demanded. To reduce loan demand sufficiently, it now may be necessary to raise interest rates to very high levels. Similarly, the removal of ceiling rates on deposits may have changed financial markets and interest rate behavior in ways that analysts have not yet fully understood. Continuing decontrol and innovation make it difficult to determine the effects of these changes. However, until these areas are thoroughly investigated, the magnitude and duration of high interest rates will remain an unsolved problem.

Research Working Papers

The following is a list of Research Working Papers published by the Federal Reserve Bank of Kansas City from March 1980 through October 1983. Copies are available from the Research Division, Federal Reserve Bank of Kansas City, 925 Grand Avenue, Kansas City, Missouri 64198.

Stuart E. Weiner
"A Survival Analysis of Adult Male Black/White Labor Market Flows," RWP 83-10, October 1983.

V. Vance Roley and Carl E. Walsh
"Monetary Policy Regimes, Expected Inflation, and the Response of Interest Rates to Money Announcements," RWP 83-09, September 1983.

Laurence Kantor and Raymond Lombra
"Interest Rate Volatility, Risk, and Investor Utility," RWP 83-08, July 1983.

David W. Berson
"The Effects of Supply Shocks on Interest Rates," RWP 83-07, July 1983.

Howard L. Roth
"Small Sample Properties of Predictors of the Estimated General Linear Model," RWP 83-06, May 1983.

Dean W. Hughes and Ann Laing Adair
"The Impacts of Recent Tax Law Changes on Investments in Agriculture," RWP 83-05, March 1983.

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"Asset Substitutability and the Impact of Federal Deficits," RWP 83-01, February 1983.

Carl E. Walsh
"The Effects of Alternative Operating Procedures on Economic and Financial Relationships," RWP 82-08, September 1982.

Robert Craig West
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