Economic Review

FEDERAL RESERVE BANK OF KANSAS CITY

November 1986

November 1986, Volume 71, No. 9

The *Economic Review* (ISSN0161-2387) is published monthly by the Federal Reserve Bank of Kansas City, except in July/August and September/October, when it is published bi-monthly. Subscriptions and additional copies are available without charge. Send requests to the Research Division, Federal Reserve Bank of Kansas City, 925 Grand Avenue, Kansas City, Missouri, 64198. Second class postage paid at Kansas City, Missouri. Postmaster: send address changes to *Economic Review*, Research Division, Federal Reserve Bank of Kansas City, 925 Grand, Kansas City, Missouri, 64198.

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Leading Indicators of Inflation

By Howard L. Roth

Some of the best economic news in recent years has come from price statistics. Consumer price inflation fell dramatically from double-digit rates in 1979 to less than 4 percent early in 1983. Inflation then remained moderate for the next three years before slowing even further when oil prices collapsed early this year.[1] The Consumer Price Index (CPI) actually declined in February through April of this year, registering the largest three-month decline since 1949.

Despite this good news, considerable uncertainty surrounds the outlook for inflation. On the one hand, continued lackluster economic growth suggests that inflation might remain moderate. On the other hand, there are a number of reasons why inflation might increase. The deflationary effects of falling oil prices have come to an end, the inflationary effects of the depreciating dollar could be just beginning, the growth of money, however defined, has been rapid, and the current expansion is entering a relatively advanced stage that in past expansions has been characterized by increasing inflation.

In view of the uncertain outlook for inflation, considerable interest has been generated lately in predicting turning points in inflation. This article assesses various leading indicators of inflation that have been developed in recent years. The article begins with a review of the behavior of consumer price inflation since 1948. It then turns to an examination of five leading indicators of consumer price inflation and provides information on what the indicators are predicting now. Most of the indicators are currently pointing upward. Confidence in this forecast, however, is weakened

[1] This inflation scenario is described by the Consumer Price Index. The Producer Price Index (PPI) and the GNP deflator give similar descriptions. This article focuses entirely on the CPI. Much of the concern about inflation relates to its impact on consumers. Prices paid by consumers are intentionally excluded from the PPI, and although consumer prices enter the GNP deflator, so do prices paid by government units and businesses. In addition, imports, which have become increasingly important in satisfying consumers' demands, are reflected in the CPI but not in the deflator. Another reason for choosing the CPI over the deflator is that the monthly CPI provides more observations on inflation than does the quarterly deflator. The specific CPI measure studied in this article is the CPI, All Urban.

Howard L. Roth is an economist at the Federal Reserve Bank of Kansas City. Michael J. Grace, a research associate at the bank, assisted in the preparation of the article.

somewhat by the newness of the indicators and uncertainty about their ability to predict future turning points in inflation.

Behavior of inflation: 1948 to 1986

Every month the Bureau of Labor Statistics (BLS) announces two sets of CPI figures, the index for the preceding month and rates of change in the index over various periods. The index itself measures the cost of purchasing a basket of goods and services in that month relative to the cost of purchasing the same items in a past reference period. For example, the index was 328.2 in August 1986, compared with 100 in the base year of 1967. This means that consumers found the goods and services covered by the CPI to be 3.282 times as expensive in August as in 1967 as a whole.

The CPI inflation figures that attract the most attention every month are the rate of change in the index over the previous month and the rate of change from the same month a year ago. The CPI was 327.6 in July 1986 and 323.1 in August 1985. Thus, consumer prices increased 0.2 percent from July to August 1986, or at a compound annual rate of 2.2 percent. From August 1985 to August 1986, consumer prices rose 1.6 percent.[2]

The measure of consumer price inflation used in this article is a variant of these approaches. The month-to-month measure is rejected because it can be quite variable, obscuring some characteristics of inflation. For example, the CPI rose at an annual rate of 4 percent from December 1985 to January 1986 and then fell almost 5 percent from January to February. Measuring inflation from the same month a year earlier, as from August 1985 to August 1986, results in a less variable measure of inflation because it averages the monthly growth rates for the 12 intervening months. However, such averaging can also eliminate important characteristics and introduce spurious ones. The measure used in this article strikes a balance between these two approaches. Specifically, it measures growth of the CPI index for a given month from its average value in the preceding 12 months.[3] This measure is less variable than the month-to-month measure and yet does not alter characteristics of inflation important to this study.[4]

Chart 1 employs this measure to depict inflation from 1948 to 1986. Three general observations can be made from the chart. First, consumer prices rose over most of this period, with the average annual rate of inflation over the entire period being slightly higher than 4 percent. Second, the rate of inflation varied considerably, ranging from −3.1 percent in July 1949 to 15.2 percent in May 1980. Third, until the last few years, the rate of inflation appeared to have trended

[2] All figures have been adjusted for seasonal effects. Seasonal adjustment of data eliminates most of the effects of changes that normally occur at about the same time and in about the same magnitude every year. For example, price data may be affected by normal weather patterns, regular production and marketing cycles, or model changeovers. Seasonal effects are of no interest in a study of the cyclical properties of an economic process and may actually obscure underlying cyclical behavior. For these seasons, studies of the cyclical behavior of economic processes are generally conducted with seasonally adjusted data.

[3] The formula used to compute inflation is

$$INF(t) = [\{CPI(t)/[\sum_{i=1}^{12} CPI(t-i)/12]\}^{**}(12/6.5) - 1.0] \times 100$$

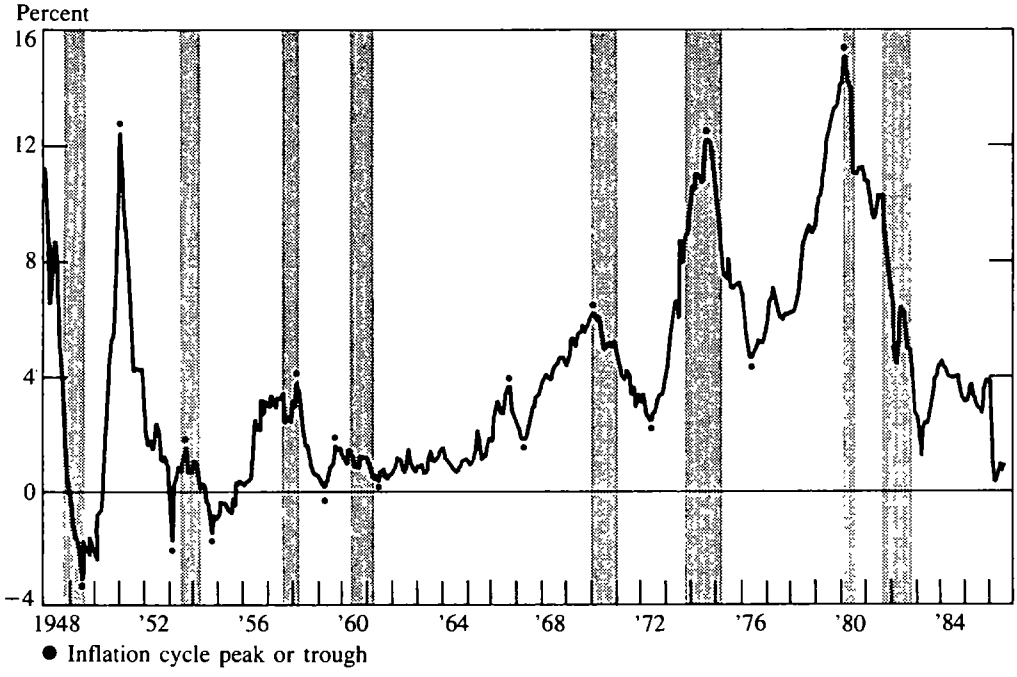
This measure is referred to as a six-month smoothed inflation rate. The "six-month" refers to the fact that the preceding 12 months are an average of six and a half months in the past. "Smoothed" refers to the use of the 12-month CPI average as a base for computing growth rather than the value of the CPI six months ago, a more variable number.

[4] This measure has been used in other inflation studies. See, for example, Geoffrey H. Moore and Stanley Kaish, "A New Inflation Barometer," *The Morgan Guaranty Survey*, July 1983; Geoffrey H. Moore, "Inflation Barometer: Rougher Weather Ahead," *The Morgan Guaranty Survey*, December 1983; Geoffrey H. Moore, "A Revised Leading Index of Inflation," Center for International Business Cycle Research, Graduate School of Business, Columbia University, February 1986, or Michael P. Niemira, "A Multiple Stage Decision Model for Forecasting Inflation," Paine Webber, July 1984.

CHART 1

Growth rate of Consumer Price Index, all urban

(Six-month smoothed rate, annualized)



upward. The average annual rate was 1.6 percent from January 1951 to December 1960, 2.9 percent from January 1961 to December 1970, and 8.1 percent from January 1971 to December 1980.

A closer examination of Chart 1 reveals that recessions slow inflation. In seven of the eight recessions shown as shaded areas in Chart 1, inflation was lower at the end of the recession than at the beginning. The brief 1957-58 recession was the exception. But it was a minor exception as inflation began a sharp decline before the 1958 recovery began. The behavior of inflation during the most recent recession was more typical. At the beginning of this recession in July 1981, the inflation rate was 10.6 percent. By the subsequent trough in November 1982, the rate had dropped to 4.3 percent.[5] Not only was inflation lower at the end of all but one recession, but in most cases, the rate of inflation continued to fall after business had started to recover. As the most recent example, inflation has continued to fall since the trough of the business cycle in November 1982.[6]

[5] Two studies of the behavior of inflation during economic slowdowns are Geoffrey H. Moore, "Recession Slows Inflation," reprinted in *Business Cycles, Inflation, and Forecasting*, Second Edition, Ballinger Publishing Company, Cambridge, MA, 1983, and Glenn H. Miller, Jr., "Slowdowns in Economic Activity and the Rate of Inflation," *Economic Review*, Federal Reserve Bank of Kansas City, September/October 1981, pp. 18-27.

[6] This description of inflation since November 1982 does not accord perfectly with Chart 1. The chart shows inflation rising between March 1983 and February 1984 and then steadily declining after February 1984. The 11-month upturn in inflation beginning in March 1983 most likely is a statistical artifact. The Bureau of Labor Statistics changed the way homeownership costs are computed in the CPI in January 1983. Other consumer price inflation measures, including an experimental CPI measure using the new methodology, show no upturn in inflation in 1983.

TABLE 1
Inflation turning points, 1948 to 1986

Trough		Peak		Change in Inflation During		Duration in months of	
Month	Inflation Rate*	Month	Inflation Rate	Expansion	Preceding Contraction	Expansion	Preceding Contraction
July 1949	−3.1	Feb. 1951	12.7	15.8	—	19	—
Jan. 1953	−1.6	Oct. 1953	1.8	3.4	−14.3	9	23
Oct. 1954	−1.2	Mar. 1958	4.0	5.2	−3.0	41	12
Apr. 1959	0.2	Oct. 1959	1.9	1.7	−3.8	6	13
June 1961	0.6	Oct. 1966	3.8	3.2	−1.3	64	20
May 1967	2.1	Feb. 1970	6.3	4.2	−1.7	33	7
June 1972	2.9	Sep. 1974	12.4	9.5	−3.4	27	28
June 1976	4.9	Feb. 1970	15.2	10.3	−7.5	45	21
Average				6.7	−5.0	30.5	17.7

*Six-month smoothed growth rate of CPI, all urban (annualized)

The chart also suggests that expansions fuel inflation. In five of the seven expansions since 1948, inflation was higher at the end of the expansion than at the beginning. The 1958-60 expansion and the recent expansion in 1981 were the two exceptions. However, the 1981 expansion was the shortest of the post-World War II expansions, which may help explain why inflation did not increase.

These regularities support the notion that inflation is related to the business cycle. Further support is seen in Table 1, which tabulates the inflation peaks and troughs marked in Chart 1. As shown in Table 1, expansionary phases of inflation cycles lasted 30.5 months, on average, during which the inflation rate rose an average of 6.7 percentage points. Contractionary phases of inflation cycles were shorter, on average, lasting 17.7 months. The rate of inflation declined 5.0 percentage points, on average, during these contractions.[7]

Five inflation indicators

As in predicting economic growth, anticipating turning points is the most difficult part of forecasting the course of inflation. In predicting growth of economic output, the difficulty of predicting turning points has led to a search for economic variables with turning points that correlate with turning points in the business cycle. Since the 1930s, the National Bureau of Economic

[7] The criteria used in specifying peaks and troughs were the size of the change in the rate of inflation and the length of time over which the change took place. Generally, a change of at least one and a half percentage points was required over a period of at least six months.

To be sure, identification of inflation troughs and peaks is somewhat arbitrary. The 1959 expansion and the 1967 contraction listed in Table 1 barely meet the criteria. And the rise in inflation in 1983 appears to be a statistical artifact and is not listed as an inflation expansion in Table 1 even though inflation increased almost 5 percentage points over an 11-month period.

Research (NBER) has identified numerous economic variables with turning points that either lead, coincide with, or lag turning points in the business cycle. The average number of hours worked by production or nonsupervisory manufacturing workers is an example of a leading indicator. In the early stages of a business recovery, businessmen usually increase the hours of their existing workers before hiring additional workers. Similarly, when business slackens, hours are cut before layoffs are made. The Department of Commerce takes the identification of indicator variables a step farther by combining the best of each category in composite indexes.

Interest in finding indicator variables for inflation has been a more recent development. The low and stable inflationary environment of the post-Korean War 1950s and the 1960s provided little incentive to find inflation indicators. But sharp increases in both the level and the variability of inflation in the 1970s focused the attention of economists on the inflationary process. Although no effort as comprehensive as the NBER business cycle indicator study has been undertaken, a number of leading indicators of inflation have been proposed, including two composite leading indexes.

Several characteristics are sought in choosing indicator variables, whether for the business cycle or inflation. First, the indicator should represent an important economic process and accurately measure it. In this respect, the price of an extensively used industrial commodity, such as crude oil, would be a better leading indicator of inflation than a commodity used relatively little, such as pine tar. Also a variable used as a leading indicator should not be subject to major revisions. Second, the indicator should bear a consistent relationship over time with movements and turns in the business cycle or inflation, as the case may be. Leads or lags should be fairly constant in length and anticipate or echo a high percentage of the turning points in the process being studied. Third, the indicator should not be dominated by irregular and noncyclical movements. A common fault of indicators is the presence of fluctuations of very short duration, or "noise," that tend to mask important cyclical movements. Fourth measurements of the indicator need to be promptly available and frequently reported. Because of their greater frequency, monthly statistics are preferred, other things equal, to quarterly statistics.

This article analyzes five leading indicators of inflation. They include two composite indexes—one developed by Geoffrey H. Moore of the Center for International Business Cycle Research at Columbia University and the other compiled by Michael Niemira of Paine Webber.[8] A third indicator, developed by John Morosani of Cyrus J. Lawrence Inc., is based on the ratio of the Federal Reserve's measure of industrial capacity utilization to its measure of the trade-weighted value of the dollar. A fourth indicator is the rate of increase of an index of spot prices for 18 industrial materials prices. This index is computed and published by the *Journal of Commerce*.[9] The

[8] Sources: Center for International Business Cycle Research Graduate School of Business, Columbia University, and Paine Webber. The two composite indexes have been constructed using the Department of Commerce's methodology for compiling the business cycle composite indexes.

[9] Sources: *Journal of Commerce*, Knight-Ridder, Inc. The 18 industrial materials are burlap, cotton, polyester, printcloth, scrap steel, copper scrap, aluminum, zinc, lead, tin, hides, rubber, tallow, plywood, corrugated boxes, red oak, benzene, and crude oil. The *Journal of Commerce* industrial materials price index was recently revised. The earlier index covered the prices of 15 industrial materials. In the revision, the prices of turpentine, linseed oil, and silk were deleted and the prices of crude oil, aluminum, plywood, red oak, benzene, and corrugated boxes were added. The most important addition in the current environment is crude oil. The original index was developed by J. Roger Wallace when he was associate editor and economist of the *Journal of Commerce*. The new index was compiled for the *Journal of Commerce* by the Center for International Business Cycle Research at Columbia University. For additional information on the revision of the *Journal of Commerce's* industrial materials price index, see the August 28, 1986 and September 2, 1986 editions of the *Journal of Commerce*.

fifth indicator is the rate of growth of the narrowly defined money supply, M1.[10]

The leading inflation index developed by Moore is a composite of five economic series: the percentage of the working age population that is employed; the growth rate of the industrial materials spot price index mentioned above; the growth of total business, consumer, and federal government debt outstanding; the growth rate of an index of import prices; and a Dun and Bradstreet compiled index of the consensus among businessmen regarding changes they expect in their selling prices.[11]

The first three components of the Moore index are intended to reflect the intensity of demand pressures in the labor, commodities, and capital markets, respectively. The percentage of the working age population that is employed has a direct bearing on how intensely employers have to compete for workers. When competition is high, wage inflation is likely to increase. And wage costs are usually reflected in the prices of products and services, though perhaps with some delay. The rate of increase in prices of industrial materials is usually influenced by changing economic conditions. The industrial materials included in the index are freely traded in open markets, and for that reason, their prices are sensitive to changing conditions in those markets. Furthermore, all the commodities in the index are widely used for further processing. Thus, changes in the prices of the index are likely to be reflected later in the prices of final goods. Growth in total debt generally reflects spending plans. New borrowing is often undertaken to finance the purchase of goods and services. Thus, more rapid growth of total debt might well be an early symptom of inflationary pressures stemming from increased demand for goods and services.

The two remaining components of Moore's composite index were incorporated early in 1986.[12] The growth rate of an index of import prices was included in recognition of the greater effect import prices have on consumer prices today. The Dun and Bradstreet index was added in recognition that businessmen should have an advantage in predicting where their prices are headed. The particular measure that was added is the percentage of surveyed businessmen that expect their prices to be higher in the coming quarter than in the corresponding quarter a year earlier.

The leading indicator of inflation developed by Michael Niemira is a composite of four economic series: vendor performance, the ratio of employment to population, the National Association of Purchasing Management's (NAPM) price survey index, and the Federal Reserve's trade-weighted dollar index. The vendor performance series measures the percentage of purchasing agents in the Greater Chicago area experiencing slower deliveries than a month earlier.[13] Slower deliveries often reflect a higher volume of business and,

[10] The inflation indicator properties of the pre-1980 measure of M1, which does not include other checkable deposits (OCD's), were also studied. The results for "Old M1" are not presented. The two measures of M1 had identical indicator properties until the mid-1970s because OCD's were negligible until then. Subsequently, the current M1 measure predicted inflation turning points marginably better than did Old M1.

[11] Sources: U.S. Department of Commerce, Bureau of Economic Analysis (percentage of working age population employed); *Journal of Commerce*, Knight-Ridder, Inc. (index of industrial materials prices); Board of Governors of the Federal Reserve System (growth of total debt); BLS (import prices); Dun and Bradstreet, Inc. (survey of businessmen regarding anticipated selling prices).

[12] See Geoffrey H. Moore, "A Revised Leading Index of Inflation," ... The Moore composite index was revised a second time in September 1986 to reflect changes in three of its components. The recently revised *Journal of Commerce* industrial materials price index replaces its predecessor in the Moore composite index. A BLS import price series that excludes crude oil replaces the earlier series, which included crude oil. And the growth rate of debt has been revised upward as a result of revisions in the mortgage debt of savings and loan associations.

[13] Source: Purchasing Management Association of Chicago.

Morosani Index

The Morosani Index is computed by first regressing CPI inflation on the 12-month lagged capacity utilization-dollar exchange rate ratio. The predicted values of the estimated equation are the values of the index. (Morosani uses the 12-month growth rate of the CPI as his inflation measure. The six-month smoothed rate was used in this study, however, to promote greater comparability with the other indicators. A check using the 12-month inflation measure showed no major differences.)

The OLS-estimated regression equation using data through May 1985 is

$$\underset{}{inf_t} = \underset{(-20.2)*}{-12.1} + \underset{(31.7)*}{24.7} \text{ (capacity utilization/dollar)}_{t-12}$$

t = 1968:1 to 1986:5
R^2 = 0.82
DW = 0.18

Because the explanatory variable is lagged 12 months, the estimated equation can be used to generate forecasts up to 12 months into the future.

With the announcement of new data each month, the equation is re-estimated and 12 new forecasts are generated.

*t-statistics in parentheses

therefore, can presage price increases. The NAPM price survey index summarizes recent price experiences and expectations of 250 purchasing managers concerning the prices they face.[14] In many instances, changes in input prices are later reflected in the prices of output. The trade-weighted value of the dollar summarizes in one number the individual exchange rates of the dollar against ten major foreign currencies.[15] The exchange rate of the dollar is a direct determinant of the cost of imports to domestic consumers as well as a constraint on the prices set by domestic producers of import-competing goods. When the dollar appreciates, as it did in the early 1980s, the prices of imports and of domestically-produced import-competing goods tend to grow more slowly, perhaps even declining. Thus, an appreciating dollar has a restraining effect on consumer price inflation. Conversely, a falling dollar can lead to higher inflation—the current concern.

The leading inflation indicator developed by John Morosani of Cyrus J. Lawrence Inc. is based on the ratio of the Federal Reserve's capacity utilization measure to the trade-weighted value of the dollar. (See the accompanying box for technical details.) This ratio is used in predicting the inflation rate 12 months in the future. The rate of capacity utilization is intended to capture the effect of demand pressures in the economy, and the trade-weighted value of the dollar is intended to measure the delayed effects of changes in the dollar's value on consumer price inflation.

[14] Source: National Association of Purchasing Managers.

[15] Source: Board of Governors of the Federal Reserve System.

CHART 2

CPI inflation and five leading indicators

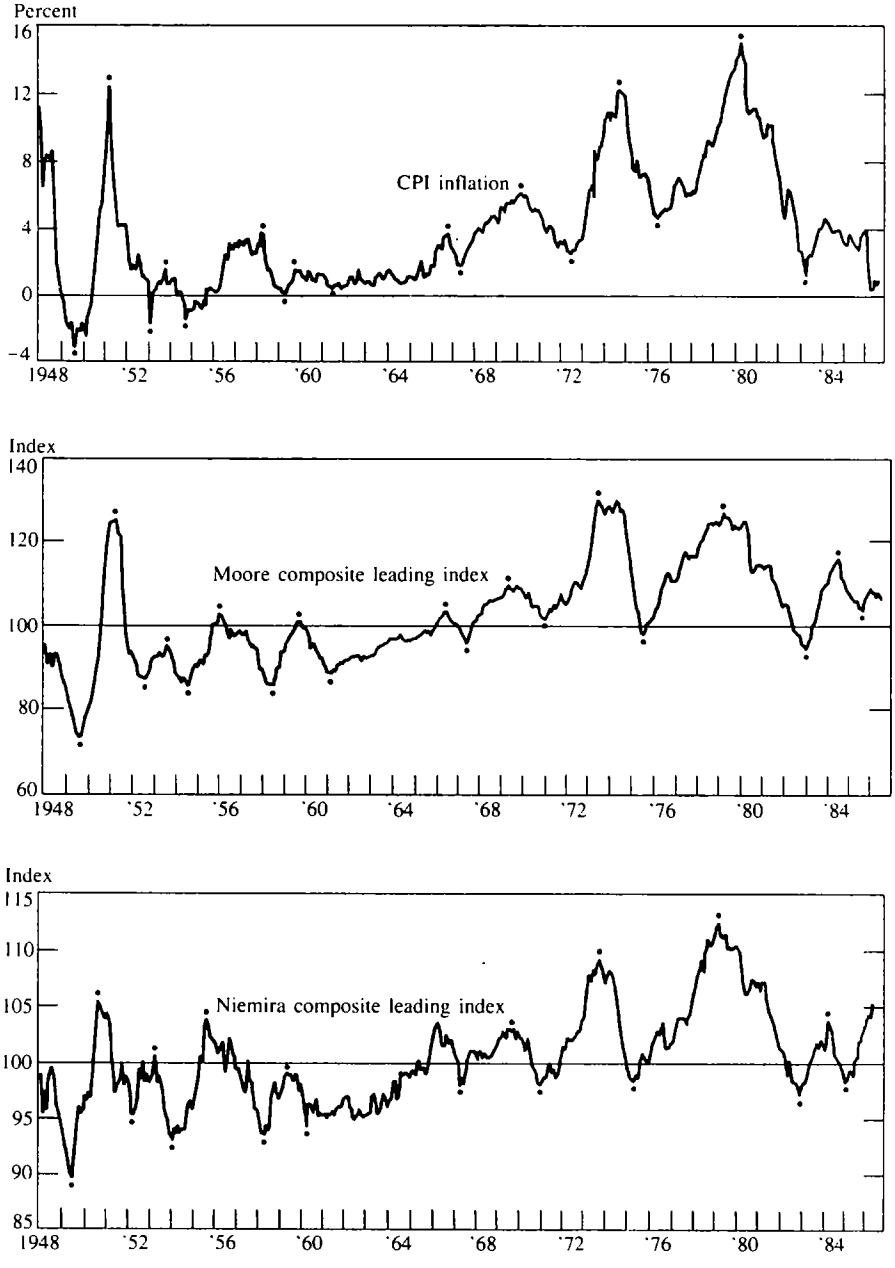
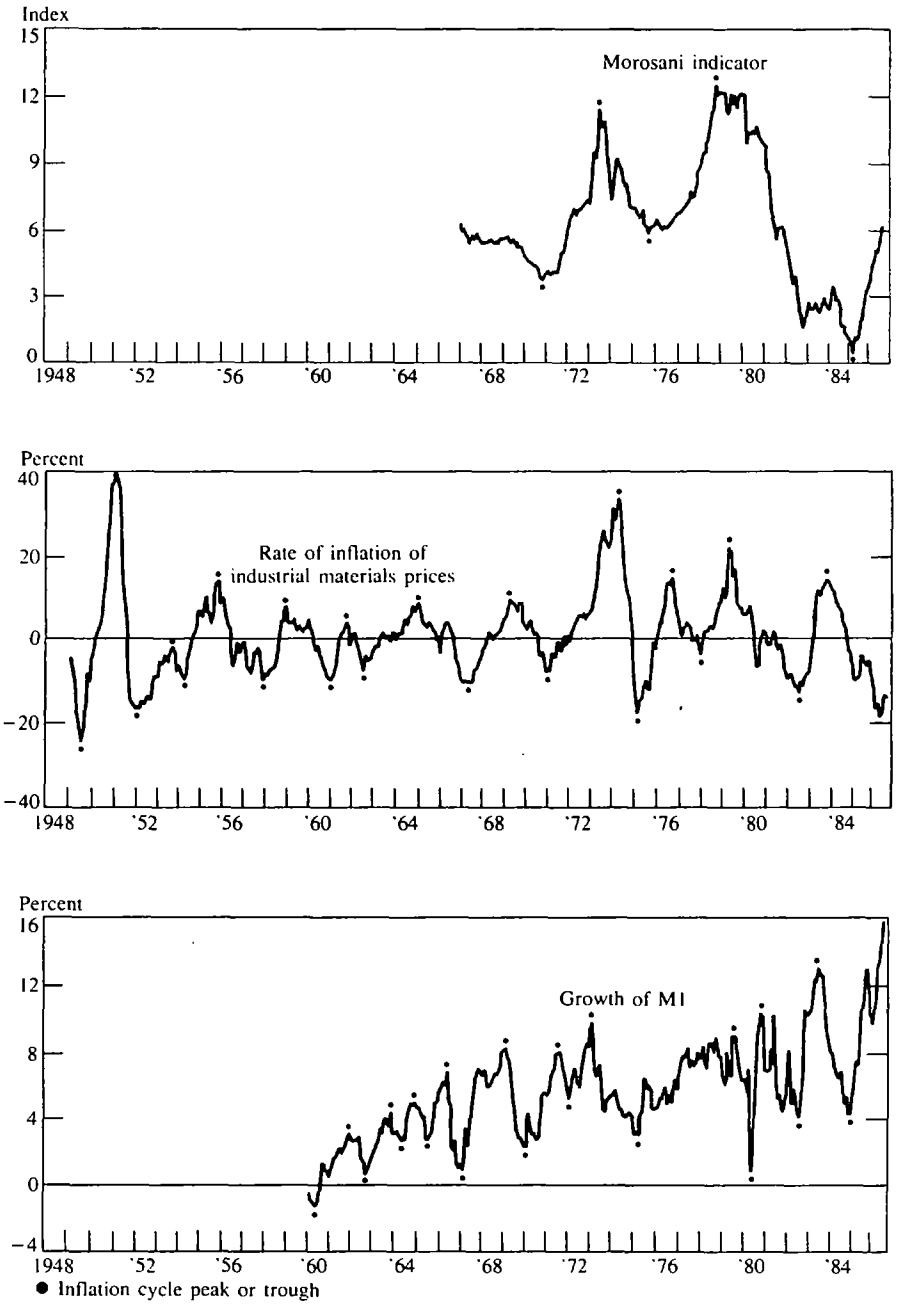


CHART 2 (continued)



Increases in capacity utilization and decreases in the trade-weighted value of the dollar push the Morosani indicator higher. Conversely, declines in capacity utilization and increases in the trade-weighted value of the dollar move the indicator lower.

The fourth inflation indicator is the *Journal of Commerce's* index of spot market prices for 18 industrial materials, the second component of Moore's composite index. The industrial materials price index was developed to give early signals of inflation or disinflation.

The remaining inflation indicator is the growth rate of M1. Reference to this measure has been made frequently in support of inflation predictions. To be sure, what is being predicted is typically a change in the average level of inflation, not a turning point. Nevertheless, M1 has been included in the study to see how well its growth rate anticipates turning points in inflation.

Chart 2 brings together the five leading inflation indicators and CPI inflation. The Moore, Niemira, and industrial materials indexes extend back to January 1948. Monthly data on M1 starts in January 1959. The Morosani index begins even later, in January 1967. Peaks and troughs in the series are marked. In general, the indicators and the CPI inflation measure show broadly similar fluctuations. Similarities between M1 growth and CPI inflation, though, are the most difficult to discern, particularly after 1979.

Performance of the indicators

How well do the five indicators perform? It is difficult to give a definitive answer to this question because the indicators are new and have not yet established a track record. Nonetheless, it is possible to provide some assessment by examining how closely turns in the indicators would have corresponded to past turns in inflation and how well the indicators would have predicted past turning points in inflation.

Correlation with inflation turning points

With respect to how closely turns in the indicators correspond to past turns in inflation, a perfect indicator would turn before each turn in inflation, lead inflation the same number of months every time, and turn only before turns in inflation. Table 2 documents how well the indicators meet these criteria.

The data in the upper half of Table 2 indicate how consistently the indicators turn before turns in inflation. For example, the Moore index turns one month before the July 1949 inflation trough. In fact, the Moore index and the other indicators almost always turn before inflation, as is evident from the predominance of minus signs. In addition, not one of the indicators misses an inflation turning point.

Data in the lower half of Table 2 show the average number of months that turns in the indicators lead or lag turns in inflation and the standard deviations of these leads and lags.[16] The average lead of the Moore composite index is 7.7 months, and the average lead of the Niemira composite index is 9.8 months. The other three inflation indicators turn earlier than the composites. The Morosani index leads CPI inflation an average of 14.8 months. But this average is based on only four observations. The average lead of the industrial materials index is about 12 months. M1 leads inflation by 13.4 months, on average. None of the indicators have constant leadtimes, as indicated by the standard deviations listed in Table 2. The Morosani indicator has the least variable

[16] The standard deviation of a series of numbers is a measure of the extent to which the numbers vary around their mean value. The mean of a data series x_t (t=1, ..., N) is defined as

$$\text{Mean} = \bar{x} = (1/N) \cdot \sum_{t=1}^{N} x_t$$

The standard deviation is defined as

$$\text{Standard Deviation} = \{[1/(N-1)] \cdot \sum_{t=1}^{N} (x_t - \bar{x})^2\}^{1/2}.$$

TABLE 2
Turning points of inflation indicators

Inflation Troughs (T) and Peaks (P)*	Number of Months that Indicator Turning Points Lead (−) or Lag (+) Inflation Turning Points				
	Moore	Niemira	Morosani	Industrial Materials Prices	M1
July 1949 (T)	−1	−1	NA	−1	NA
Feb. 1951 (P)	+1	−6	NA	−3	NA
Jan. 1953 (T)	−7	−10	NA	−14	NA
Oct. 1953 (P)	−3	−7	NA	−2	NA
Oct. 1954 (T)	−3	−9	NA	−8	NA
Mar. 1958 (P)	−27	−30	NA	−30	NA
Apr. 1959 (T)	−11	−12	NA	−17	NA
Oct. 1959 (P)	−2	−6	NA	−11	NA
June 1961 (T)	−4	−15	NA	−6	−14
Oct. 1966 (P)	−4	−7	NA	−23	−6
May 1967 (T)	0	−2	NA	−5	−4
Feb. 1970 (P)	−5	−6	NA	−11	−13
June 1972 (T)	−19	−18	−19	−18	−29
Sep. 1974 (P)	−15	−11	−14	−6	−20
June 1976 (T)	−11	−15	−9	−17	−14
Mar. 1980 (P)	−12	−2	−17	−12	−7
	Mean lead (−) or lag (+) in months				
All turning points	−7.7	−9.8	−14.8	−11.5	−13.4
Troughs	−7.0	−10.3	−14.0	−10.8	−15.3
Peaks	−8.4	−9.4	−15.5	−12.3	−11.5
	Standard deviation of leads and lags in months				
All turning points	7.4	7.1	3.8	7.8	7.7
Troughs	6.0	5.7	5.0	6.1	8.9
Peaks	8.6	8.1	1.5	9.1	5.6
	Number of extra turning points†				
	2	2	0	6	8

*Six-month smoothed growth rate of CPI, all urban (annualized)
†No corresponding turning points in the CPI growth rate. The Moore composite index has extra turning points in December 1982 (T) and June 1984 (P). The Niemira composite index has extra turning points in November 1982 (T) and March 1984 (P). The industrial materials prices index has extra turning points in September 1961 (P), July 1962 (T), July 1976 (P), September 1977 (T), June 1982 (T), and September 1983 (P). M1 has extra turning points in November 1961 (P), September 1962 (T), November 1964 (P), June 1965 (T), May 1980 (T), October 1980 (P), July 1982 (T), and May 1983 (P).
NA: Data not available

leadtime. But again, this statistic is based on only four observations. The variabilities of the leads of the other four indicators are broadly similar.

The bottom line of Table 2 reveals that the Morosani indicator has no "extra" turning points—turning points that do not correspond to turning points in CPI inflation.[17] The two composite indexes each have two extra turns, the industrial materials price index has six, and M1 has eight.

Predictions of inflation turning points

A second way of evaluating the inflation indicators is according to how well they can be used to generate early warning signals of cyclical swings in inflation. How this criterion differs from the criterion used in Table 2 can be illustrated by a hypothetical example. Suppose an inflation indicator has declined one month after having climbed steadily over the preceding year. Suppose further that inflation also has been increasing steadily, with no signs of moderating. Generally, a one-month decline in the indicator would not justify a warning that inflation is about to fall. One-month declines in indicators are often reversed the following month.

What would warrant a prediction of falling inflation, generally, is any behavior of the indicator that in the past has been associated with downturns in inflation. This behavior might be a number of consecutive monthly declines of the indicator when inflation has been increasing. Or it might be a critical percentage decline of the indicator. These are only two of many possible rules for determining when the behavior of the indicator justifies warning that inflation is about to fall. If, in fact, a warning signal is given and inflation actually falls, three events will have taken place—the indicator will have turned, the indicator will have given a warning signal that inflation is about to fall, and inflation will have fallen. In terms of these three events, the criterion used in the analysis underlying Table 2 was how well turns in the indicator correlate with turns in inflation. The criterion used in this section is how well the indicator signals turns in inflation.

In a sense, the second criterion is an extention of the first. The ability to signal cyclical swings in inflation depends on how closely the turning points of the indicator are correlated with turning points in inflation. But the ability to signal cyclical swings in inflation also depends on how strongly the indicator moves in anticipation of a cyclical swing in inflation and how well the conditions under which the indicator anticipates a turning point in inflation can be summarized by a rule for signaling turning points.

Why is a rule for signaling turning points needed? As in the hypothetical example, early warnings of cyclical swings in inflation must be given in practice without knowledge of future values of both inflation and the indicator. The rule compensates for this lack of knowledge about the future.

Of the five indicators, only Moore's index has a turning point rule specified for it. The rule is based on growth of the index, calculated according to the formula used to measure inflation in this study. A peak is signaled the first month growth falls below -1.0 percent. Similarly, a trough is signaled the first month growth exceeds 1.0 percent. As will be seen below, this rule allows the Moore index to signal all the inflation turn-

[17] Extra turning points are also a problem of the composite business cycle indicators. Efforts have been made to alleviate this problem in the case of composite index of leading business cycle indicators. See Saul H. Hymans, "On the Use of Leading Indicators to Predict Cyclical Turning Points," *Brookings Papers on Economic Activity*, February 1973, pp. 339-84, Stephen Beveridge and Charles R. Nelson, "A New Approach to Decomposition of Economic Time Series with Attention to Measurement of the 'Business Cycle,'" *Journal of Monetary Economics*, 7, March 1981, pp. 151-174, and Carl J. Palash and Lawrence J. Radecki, "Using Monetary and Financial Variables to Predict Cyclical Downturns," *Quarterly Review*, Federal Reserve Bank of New York, Summer 1985, pp. 36-45, and the references therein.

ing points in Table 1, although frequently signaling only after the fact.

Turning point rules were developed in this study for the other four indicators. The objective was to find rules that allow the indicators to signal past turning points accurately, the hope being that the rules will continue to work in the future. Developing good rules for some of the indicators was quite involved. Fortunately, this was not the case with the Niemira index. The rule developed for the Moore index works well for the Niemira index.

The rule developed for the Morosani index compares the predicted change in the rate of inflation in the next 12 months with the change in the rate of inflation in the preceding 12 months.[18] A trough is signaled the first month the predicted change in inflation in the next 12 months is positive, the change in the preceding 12 months is negative, and the difference between the two changes exceeds two percentage points. The peak signal is the mirror image of the trough signal.

The rule for the M1 indicator compares current growth of M1 with its average growth in the previous 12 months. A trough is signaled the first month that growth exceeds the average by at least two percentage points. A peak is signaled the first month M1 growth falls below the average by at least two percentage points.

The rule for the raw industrial materials index is also based on the difference between the growth of the index and its average growth in the previous 12 months. But prices of raw industrial materials can swing widely. For that reason, a trough is not signaled until the index exceeds the average by at least 2.5 percentage points for three consecutive months. A peak is not signaled until the index falls below the average by at least 2.5 percentage points for three consecutive months.

[18] The most recent data used in estimating the Morosani equation was from the period in which the predictions would have been made. (See box on page 9 for details.)

In signaling turns in inflation, a perfect indicator signals every turn in inflation, gives its signal the same number of months ahead or behind every time, and does not give false signals. Table 3 documents how well the indicators meet these criteria.

The data in the upper half of Table 3 indicate how successfully the indicators signal past turns in inflation. For example, the Moore index signals the July 1949 trough in inflation four months later, in November 1949. This signal only confirms a turn in inflation, as do almost half of the signals recorded in Table 3. But confirming signals can be useful. In practice, it takes time to determine whether a change in the rate of inflation is temporary or the beginning of a new phase. An indicator that signals at or soon after turning points in inflation can help make the distinction. A confirming signal is at least more informative than no signal. Missed signals are not a problem, however. The only miss is committed by the M1 index.

Data in the lower half of Table 3 report the average number of months of advanced warning given by the indicators and the variability of these warnings. The average warnings range from 2.8 months for the Moore composite index to ten months for the Morosani indicator. The Niemira composite index signals slightly earlier, on average, than the Moore index. The Moore index has the least variable leadtime, although no major differences were found in the variabilities of the indicators, as indicated by the standard deviations listed in Table 3.

The bottom line of Table 3 reveals that only the Morosani indicator succeeds in giving no false signals. The Moore composite index makes two false signals. The Niemira composite index and the M1 indicator each make four false signals. The industrial materials price index gives six false signals.

Of the five inflation indicators, the two composite indexes best meet the criteria underlying

TABLE 3
Turning point signals given by inflation indicators

Inflation Troughs (T) and Peaks (P)*	Number of Months that Indicator Turning Point Signals Lead (−) or Lag (+) Inflation Turning Points				
	Moore	Niemira	Morosani	Industrial Materials Prices	M1
July 1949 (T)	4	2	NA	NA	NA
Feb. 1951 (P)	4	2	NA	1	NA
Jan. 1953 (T)	−2	−6	NA	−5	NA
Oct. 1953 (P)	0	−3	NA	2	NA
Oct. 1954 (T)	0	−2	NA	−5	NA
Mar. 1958 (P)	−21	−25	NA	−26	NA
Apr. 1959 (T)	−7	−8	NA	−10	NA
Oct. 1959 (P)	3	3	NA	4	NA
June 1961 (T)	2	3	NA	−3	M
Oct. 1966 (P)	−1	2	NA	−16	−3
May 1967 (T)	3	4	NA	4	1
Feb. 1970 (P)	−2	0	−11	−4	−8
June 1972 (T)	−13	−6	−23	−10	−21
Sep. 1974 (P)	−3	−3	−8	−4	−13
June 1976 (T)	−5	−8	−4	−9	−12
Mar. 1980 (P)	−7	−7	−4	−7	0
	Mean lead (−) or lag (+) in months				
All turning points	−2.8	−3.3	−10.0	−5.9	−8.0
Troughs	−2.3	−2.6	−7.7	−5.4	−10.7
Peaks	−3.4	−3.9	−13.5	−6.3	−6.0
	Standard deviation of leads and lags in months				
All turning points	6.5	7.0	7.0	7.6	7.4
Troughs	5.4	4.7	2.9	4.6	9.0
Peaks	7.4	8.6	9.5	9.5	5.0
	Number of false signals†				
	2	4	0	6	4

*Six-month smoothed growth rate of CPI, all urban (annualized)
†Signaled turning point did not materialize. The Moore composite index gives false signals in March 1983 (T) and September 1984 (P). The Niemira composite index gives false signals in June 1962 (P), April 1963 (T), April 1983 (T), and August 1984 (P). The industrial material prices index gives false signals in March 1962 (P), April 1963 (T), October 1976 (P), June 1978 (T), December 1982 (T), and February 1984 (P). And M1 gives false signals in September 1980 (T), July 1981 (P), October 1982 (T) and November 1983 (P).
M: Indicator fails to signal turning point in CPI
NA: Data not available

Tables 2 and 3. Both composite indexes match every turn in inflation. Both composites make only two extra turns. Both signal every turning point in inflation. The Moore index gives two false signals and the Neimira index four. The Morosani indicator makes no errors, but its record is very short. The industrial materials price index and M1, on the other hand, are considerably less promising. Both the industrial materials price index and M1 make too many extra turns and give too many false signals. In addition, M1 fails to signal one inflation turning point.

Qualifications

Tables 2 and 3 might put the inflation indicators in too favorable a light. A few qualifications should be made. First, the indicators, except for M1, were specifically designed to anticipate past turning points in the rate of inflation. That they perform this task well should not be surprising. But this ability to predict past turning points in inflation does not ensure success in anticipating future turning points in inflation. The underlying economic processes that led to the correlations between the indicators and inflation could change. As cases in point, the Niemira composite leading inflation index has been revised once and the Moore composite index has been revised twice in the past two years to reflect the growing importance of imports on consumer price inflation. The composite indexes are new, and it is reasonable to expect that some initial refinement may be needed. But if they continue to need modifying every two or three years, the indexes will be of little use.

Second, a similar point can be made regarding turning point rules. These rules were designed to explain the past. Turning point rules are limited in number and complexity only by the imagination. With perseverance, a rule can be found to explain the past. But there is no guarantee that the rule will work well in the future.

The last two points are part of a more general criticism—that the indicator approach is really measurement without theory.[19] The root of this criticism is that the indicators do not emerge naturally from a rigorous theoretical model of the economy.[20] Rather, the variables used as indicators or as components of composite indexes simply make sense.[21] Without a theoretical model, it is difficult to explain or predict changes in the relationships between variables. This shortcoming can lead to problems. For example, suppose two economic variables have been highly correlated and that, as a result, one of the variables has been an excellent indicator of the other. The two variables need not be directly related. Their correlation could arise from them being related to a third variable. If a change in the economy resulted in the third variable being no longer related to either of the two original variables, the correlation observed between the two original variables might disappear.

Third, completely revised data was used in evaluating the indicators. In practice, much of the data is subject to revision. Reliance on preliminary data could degrade the performance of the indicators. An analysis of the indicators' performance based on originally published data is beyond the scope of this study, but the possibility cannot be dismissed that the results reported here are biased favorably by use of revised data.

[19] See, for example, Alan J. Auerbach, "The Index of Leading Indicators: 'Measurement Without Theory,' Thirty-Five Years Later," *The Review of Economics and Statistics*, November 1982, pp. 589-95.

[20] Much of applied macroeconomics is subject to this criticism, which probably says as much about the state of theoretical macroeconomics as it does about the practice of applied macroeconomics.

[21] The good performance of the Morosani index does not make sense in one respect. The index relies on the level rather than the growth rate of the trade-weighted value of the dollar. Intuitively, the growth rate of the dollar would be expected to be more closely correlated to inflation than is the level of the dollar.

TABLE 4
Behavior of the inflation indicators since the February 1984 peak in CPI inflation*

Indicator	Indicator Turning Points (all troughs)	Signals Given by Indicators (all troughs)
Moore	September 1985	November 1985
Niemira	February 1985	August 1985
Morosani	January 1985	February 1986
Industrial material prices	—	—
M1	October 1984	May 1985

*The February 1984 peak in CPI inflation was the most recent cyclical swing in inflation.

What are the inflation indicators saying now?

Considerable uncertainty surrounds the current outlook for inflation. The steady decline in the dollar's value since early 1985 and the dramatic fall in oil prices in early 1986 are the most frequently cited events when current inflation is analyzed and predictions for 1987 are made. The fall in oil prices had almost an immediate effect, driving consumer price inflation on a month-to-month basis below zero for three consecutive months early this year. The effect of falling oil prices appears to have run its course, however. The effect of the decline in the dollar, on the other hand, has been limited so far, manifesting itself primarily in increases in the prices of some manufactured imports. The questions asked most often are, will the fall in the dollar become the main influence on consumer price inflation and, if it does, when will it increase inflation and how much?

Most of the inflation indicators analyzed in this article point toward higher inflation. As shown in Table 4, four of the five indicators reached troughs in either late 1984 or 1985. Only the industrial materials price index has not turned upward yet. Table 4 also shows that all of the indicators except the industrial materials price index have signaled an upturn in inflation in the past two years. The Morosani indicator was the most recent to signal an upturn, in February 1986.

Differences in how the indicators are affected by oil prices and the dollar's exchange value explain why the two composite indexes and the Morosani indicator are pointing toward higher inflation while the industrial materials price index is not. The fall in oil prices beginning late last year has kept the industrial materials price index from turning up.[22] Because this index is a component of the Moore composite index, falling oil prices also have had a moderating influence on the Moore index. But the falling dollar has more than offset the effect of falling oil prices on the Moore index by pushing up another component of the Moore index—prices of imports excluding crude oil. The falling dollar also is clearly respon-

[22] The earlier index, which did not include crude oil, turned up in December 1984.

TABLE 5
Predictions of inflation

	R^2	Inflation Prediction: Date	Inflation Prediction: Rate
Moore: $\hat{inf} = -22.8 + 0.261$*(Moore Index)$_{-7}$ (−29.4) (34.9)	0.73	Feb. 1987	5.2%
Niemira: $\hat{inf} = -71.4 + 0.750$*(Niemira Index)$_{-9}$ (36.6) (38.7)	0.77	Feb. 1987	7.7
Morosani: $\hat{inf} = -12.05 + 24.75$*(cap util/dollar)$_{-12}$ (−20.2) (31.7)	0.82	Aug. 1987	6.1
Industrial Materials: $\hat{inf} = 3.97 + .170$*(growth in ind. material price index)$_{-11}$ (26.1) (11.3)	0.23	July 1987	1.7
M1: $\hat{inf} = 1.85 + 0.612$*(growth in M1)$_{-12}$ (4.4) (9.11)	0.21	Aug. 1987	11.5

Definitions: $\hat{inf}$ = predicated CPI inflation
cap util = industrial capacity utilization rate, Federal Reserve
dollar = trade-weighted exchange value of the dollar, Federal Reserve
Ind. material price index = *Journal of Commerce* index of 18 industrial materials prices

Notes: Figures in parentheses are t-statistics.
The lags chosen for the indicators are the average number of months the indicators turn before CPI inflation (see Table 2).

sible for the increase in the Morosani indicator. The only other variable entering this indicator is industrial capacity utilization. Capacity utilization has gradually fallen for the past few years, having an opposite but much smaller effect on the Morosani indicator than has the decline of the dollar. The dollar also directly enters the Niemira composite index, and the fall in the dollar is the primary reason this index is predicting an upturn in inflation.

Four of the five indicators have reached troughs in the past two years and have signaled rising inflation, but concern about an upturn in inflation should be tempered for two reasons. First, the indicators are new. Their predictive abilities have not been demonstrated in practice. Second, the indicators are not independent of each other. The value of the dollar figures prominently in three of them. The price of oil is important in at least two. Thus, the troughs reached by the four indicators are probably not four independent pieces of evidence that inflation will soon reach a trough.

Numerical forecasts of inflation are more difficult to obtain from the indicators. Only the Morosani indicator gives a direct numerical forecast of inflation. In August 1986, this indicator was predicting consumer price inflation of 6.1 percent by August 1987, an increase of almost five percentage points. Although the other four

indicators are not designed to provide numerical forecasts of inflation, rough indications can be obtained by referring to the past correlations between the indicators and consumer price inflation. These indications have been obtained through regression techniques, and the resulting equations are given in Table 5. The predictions range from the industrial materials price index's forecast of 1.7 percent in July 1987 to the M1 indicator's prediction of 11.5 percent by August 1987. The M1 and industrial materials prices equations have very little explanatory power, however, and their predictions ought to be discounted. The average prediction of the other three indicators is 6 to 6.5 percent consumer price inflation early in 1987.

Conclusion

Five leading indicators of inflation have been examined in this article. Two are composite indexes patterned after the composite leading indicator of the business cycle. The other three are simpler. The indicators, particularly the composite indexes, anticipate past turning points quite well. The growth rate of M1 turns more frequently than consumer price inflation, however, and is, therefore, too prone to predict inflation turning points. Rules for signaling inflation turning points based on the behavior of the indicators were also analyzed. A rule was found that allowed each indicator to signal past turning points in inflation with at least some degree of success.

Most of the indicators currently point toward higher inflation. Four of five have reached troughs in the last two years and have signaled an upturn in inflation. These predictions are cause for concern. The concern should be tempered, however, by awareness that the indicators are new. Their success in explaining past turning points in inflation should come as no surprise. The indicators, except for M1, were specifically designed to predict past turning points in inflation. Their ability to predict future turning points in inflation remains to be seen.

The Farmers Home Administration: Where is it Headed?

By Kim Norris

The financial condition of the Farmers Home Administration (FmHA) has deteriorated markedly in recent years. Because the purpose of the agency is to provide credit to farmers that cannot obtain funds elsewhere, its loan portfolio has always been dominated by highly leveraged, financially weak borrowers. The FmHA has been an especially popular source of credit in recent years, as declining land values, crop prices, and farm income have weakened the financial condition of more and more farmers. As a result, the farm loan programs administered by the FmHA have grown rapidly and loan delinquencies and losses have mounted.[1]

The deteriorating performance of the FmHA's loan portfolio raises questions not only about the cost of FmHA farm programs but also about how the FmHA can best carry out its mission. Although the FmHA plays a critical role as a farm lender of last resort, sharp deterioration in the quality of its loan portfolio suggests that new program directions may be needed. This article reviews the recent growth in FmHA farm loan programs, examines the deteriorating performance of these loans, and explores some possible future program directions for the agency.

FmHA and its objectives

FmHA's roots go back to the Resettlement Administration established in 1935. One of the Resettlement Administration's functions was to make loans to depression-stricken farm families and help them regain their ability to make a living from farming. The Resettlement Administration was renamed the Farm Security Administration (FSA) in 1937, and for the next ten years the FSA carried out federal farm credit programs. Many argue that FSA loan programs strengthened

[1] In 1986, the General Accounting Office prepared no fewer than three reports on the financial condition of the FmHA. They include "Farmers Home Administration: Financial and General Characteristics of Farmer Loan Program Borrowers" and "Farmers Home Administration: An Overview of Farmer Program Debt, Delinquencies, and Loan Losses." The third report will be released in late 1986.

Kim Norris is an assistant economist at the Federal Reserve Bank of Kansas City.

family farm agriculture and helped the United States meet the demand for food during World War II. By the mid-1940s, however, many of the original resettlement programs had become obsolete and programs with new objectives were needed for the postwar era.

The Farmers Home Administration was created in 1947 to take the place of the FSA. Since then, the FmHA's function has been to supplement private sector credit in rural areas by providing financial and technical assistance where none would otherwise be available. The FmHA requires that its borrowers be unable to obtain credit from usual commercial credit sources. Even so, the agency generally applies some type of loan eligibility standard—such as cash flow measures—to its borrowers. Ultimately, the "goal of FmHA farm credit is to help farmers attain self-sufficiency and to graduate to commercial credit as soon as possible."[2]

Five broad farm loan programs are administered under the FmHA—farm ownership, farm operating, emergency disaster, economic emergency, and others such as soil and water or economic opportunity.[3] Under these programs, farm loan assistance can take the form of either direct loans or loan guarantees. Direct farm loans are made out of the Agricultural Credit Insurance Fund (ACIF)—a revolving fund started in the 1940s and funded through congressional appropriations, repayment of FmHA loans, and the sale of Certificates of Beneficial Ownership.[4] The guaranteed loan program has been in existence only since 1973. Private lenders make and service the loans, while the FmHA guarantees that some portion of the loan—up to 90 percent—will be repaid by the FmHA if the borrower defaults. Through the use of guaranteed loans, private lenders and the government share in the risk of lending to less creditworthy farm borrowers.

The FmHA also administers a number of loan programs not targeted specifically to farmers. Directed generally at rural development, most of these loans go for rural housing, community development, and rural business and industry. Although these programs account for more than half the FmHA's outstanding loans, they have not been a cause for concern. Fewer than 1 percent of these loans were delinquent in 1985. By comparison, more than a fourth of the loans in FmHA farm programs are delinquent. Most analysts agree that the nonfarm loan portfolio is and will continue to be quite healthy. Therefore, because the FmHA's present difficulties stem from the deteriorating quality of its rapidly growing farm loan portfolio, this article focuses on the farm loan programs.

Growth in the FmHA's farm loan portfolio

A decade of rapid growth

Farm loan programs administered by the FmHA have grown rapidly since the mid-1970s. Farm debt held by the FmHA increased more than 400 percent from 1976 to 1985. In comparison, total farm debt in the United States increased about 120 percent over the same period (Chart 1). FmHA's market share of farm debt has also expanded. The agency held less than 6 percent of all farm debt in 1976. By 1985, it held 13 percent.

While direct loans grew rapidly in the late 1970s, increases in loan guarantees are a more recent development. The level of direct farm lending by

[2] Farmers Home Administration, "A Brief History of the FmHA," U.S. Department of Agriculture, February 1985, addendum.

[3] Authorization for the Economic Emergency Loan Program expired in September 1984.

[4] Certificates of Beneficial Ownership are backed by FmHA-held mortgages and sold by the FmHA to the Federal Financing Bank, which uses the certificates as collateral for loans from the Treasury. Virtually all nonsubsidized FmHA lending is financed by the sale of these certificates.

CHART 1

Index of annual growth in farm debt

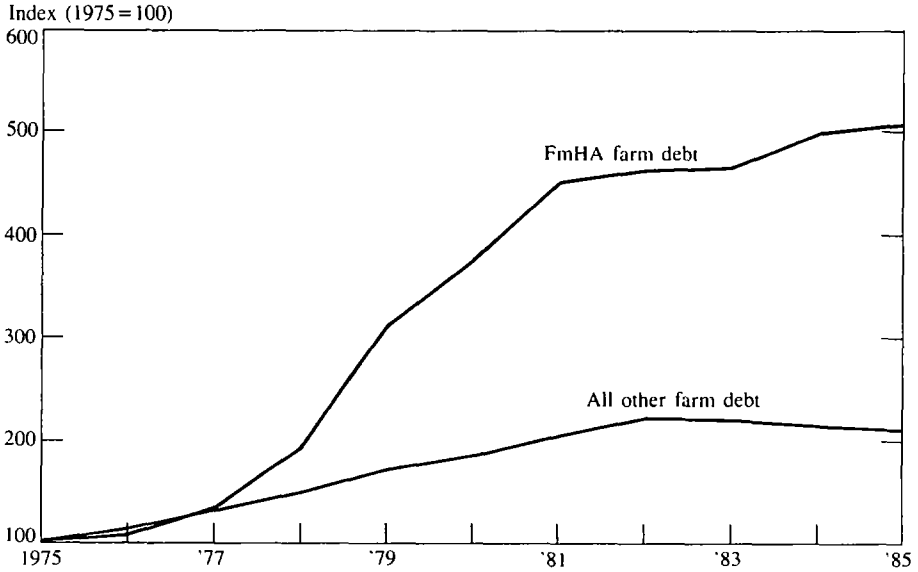
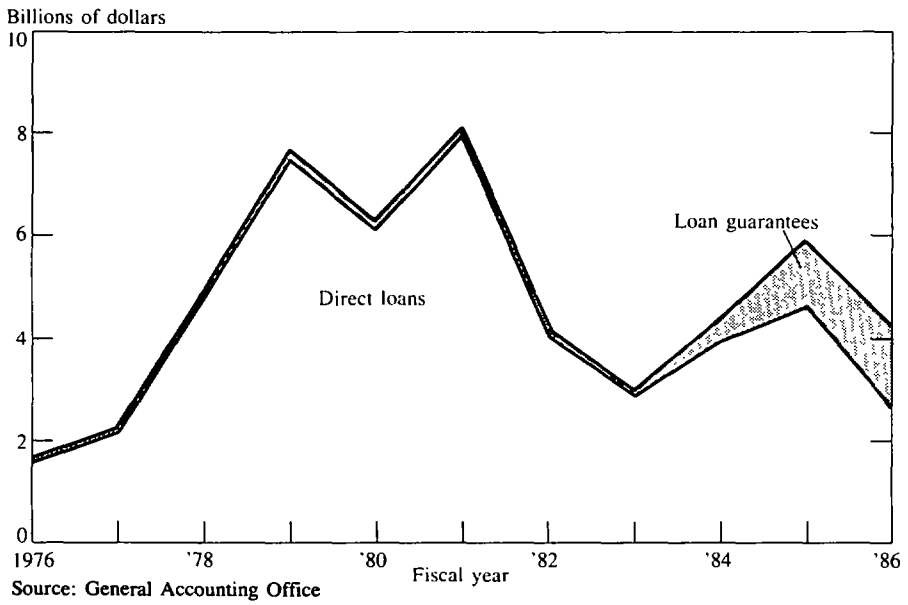


CHART 2

Annual FmHA farm program lending levels

Direct and guaranteed loans



Source: General Accounting Office

the FmHA quadrupled between 1976 and 1981, reaching a peak of nearly $8 billion a year (Chart 2). Cuts in federal spending slowed FmHA lending after 1981, but nearly $5 billion in direct farm program loans were made in 1985, more than twice the amount loaned in 1976. Large increases in FmHA loan guarantees have occurred only recently. In fiscal 1985, the FmHA guaranteed more than $1 billion in farm loans by commercial lenders—nearly as much as all the guaranteed loan activity for the previous nine years.

Growth of the FmHA's farm loan portfolio has not been even across the major farm program categories. The total outstanding principal on farm ownership loans nearly tripled between 1976 and 1986. The outstanding principal on these loans—which enable family-size farms that cannot obtain credit elsewhere to buy, improve, or refinance farm real estate—increased from $2.9 billion in 1976 to $7.6 billion in 1986.

The total outstanding principal on direct farm operating loans increased fivefold over the same period, to more than $6 billion in 1986. Operating loans are made to family-size farms to buy machinery, equipment, or livestock, to pay operating expenses, including family living expenses, to refinance past operating loans other than FmHA loans, and to pay other creditors. In 1976, FmHA direct farm operating loans totaled less than half the amount of farm ownership loans. By 1986, the two were about equal.

Increases in the previous two programs pale beside the increase in emergency disaster loans that occurred between 1977 and 1981. The principal outstanding on these loans, which help farmers recover from natural disasters such as droughts, floods, and hail, totaled less than $1 billion in 1976. By 1981, the total had jumped to more than $10 billion. Even in 1986, the outstanding principal on emergency disaster loans exceeded $9 billion.

Economic emergency loans, though short-lived, contributed noticeably to the FmHA's holding of farm debt. FmHA economic emergency loans were available to farmers from August 1978 to September 1984. Under this program, an economic emergency was defined as "a general tightening of agricultural credit or an unfavorable relationship between production costs and prices received for agricultural commodities, causing widespread need among farmers for temporary credit."[5] Direct loans of nearly $3 billion were made in 1979, the first full year the program was in operation. In 1986, the outstanding principal on direct economic emergency loans stood at $4 billion.

Farm ownership loans were the largest component of FmHA farm debt ten years ago. Now, emergency disaster loans make up a third of the debt (Chart 3). Of the major FmHA farm programs, emergency disaster loans have increased most. But that increase does not diminish the significance of growth in the other programs.

Factors contributing to growth

A series of events over the past ten years—some of them interrelated—have contributed to FmHA's burgeoning loan portfolio. These events range from the softening farm commodity markets of the late 1970s to natural disasters in 1978 and 1980 to financial deregulation in the early 1980s.

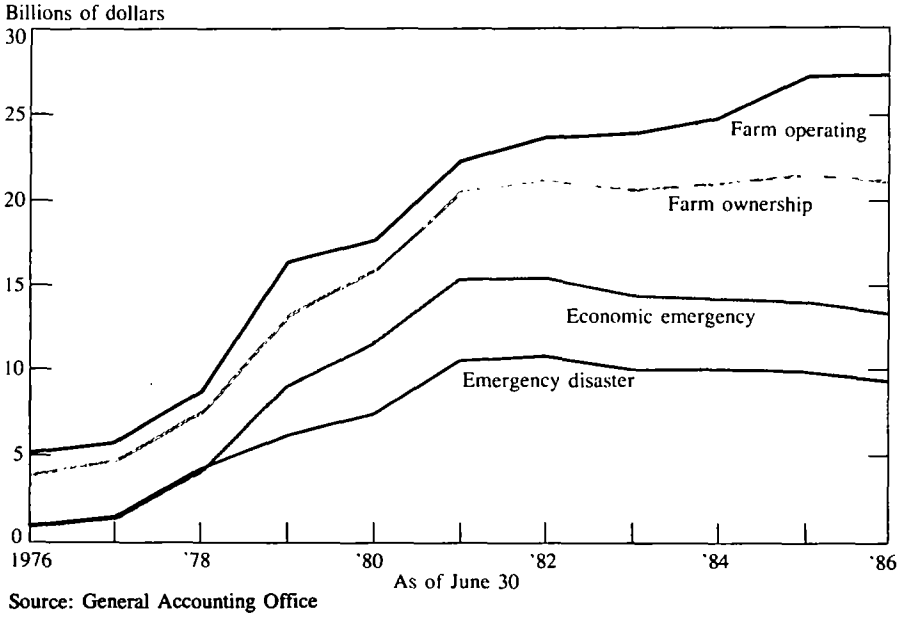
1975 to 1981. Mother nature contributed significantly to the rise in FmHA farm debt between 1975 and 1981. Natural disasters in 1978 and 1980 brought on a sevenfold increase in emergency disaster loans. About three out of every four dollars of emergency disaster loans now outstanding can be traced to the natural disasters in those two years. But nature was not the only factor at work.

[5] "Farmers Home Administration: An Overview of Farmer Program Debt, Delinquencies, and Loan Losses," General Accounting Office, January 1986, p. 45.

CHART 3

Outstanding principal on FmHA direct farm loans

By loan program category



Source: General Accounting Office

Weakening farm commodity markets in the late 1970s and the subsequent legislative response brought on further increases in FmHA lending. Crop prices were weak in the late 1970s—certainly compared with the agricultural heyday of 1973-74—and markets were volatile. Many lenders ceased their previously liberal lending practices, and farm borrowers that had been accustomed to free-flowing credit suddenly found less available. As farm credit shortages began to occur, Congress responded by enacting the Emergency Agricultural Credit Adjustment Act in 1978. That act significantly expanded the spectrum of FmHA lending in two respects. First, it substantially changed the existing FmHA farm programs by expanding borrower eligibility, increasing loan limits, and lowering interest rates. Second, it added a new program—economic emergency loans—to compensate for what were regarded as tight agricultural credit conditions. The economic emergency program remained in effect until 1984. By then, it had built up outstanding loans of $4 billion.

Despite regional shortages of farm credit in the late 1970s, farmers remained "heavily addicted to a steady flow of borrowed funds to finance their production activities."[6] Moreover, with farm real estate values rising rapidly in the late 1970s, farm operators had little motivation for managing financial risk. Instead of reducing their financial exposure by reining in expanding farm debt, farmers chose—and in some cases were encouraged—to borrow more heavily against the

[6] John E. Lee, Stephen C. Gabriel, and Michael D. Boehlje, "Public Policy Toward Agricultural Credit," *Future Sources of Loanable Funds for Agricultural Banks*, proceedings from a symposium sponsored by the Federal Reserve Bank of Kansas City, December 8-9, 1980, p. 85.

continued rise in the value of their land collateral. As farmers became more dependent on credit, farm debt mounted—a phenomenon that affected nearly all agricultural lending institutions, including the FmHA.

Thus, the late 1970s and very early 1980s was a period when private credit became tighter and more costly, when federal credit was plentiful and comparatively inexpensive, and when farmers' risk management was such that they borrowed with little hesitation. The FmHA was a source of readily available credit that farm borrowers used enthusiastically. Moreover, the strong demand for credit was accompanied by significant pressure in Congress to service farm borrowers, particularly in the late 1970s. The FmHA responded to these demands by relaxing credit standards. Peter J. Barry notes that the FmHA was later "criticized for excessive lending in some cases and unauthorized uses of loan funds by some borrowers" during this period.[7]

1981 to present. Banking deregulation in the early 1980s had a profound effect on rural financial markets, and therefore agricultural credit. By removing deposit rate ceilings, deregulation of the banking industry through the Depository Institutions Deregulation and Monetary Control Act of 1980 (DIDMCA) made agricultural banks compete more directly with other depository institutions for funds. Rural banks could no longer hold the large pool of low-cost demand deposits that had insulated them against unfavorable fluctuations in interest rates. Faced with increased competition and the integration of rural financial markets, agricultural banks passed their rising costs on to borrowers in the form of higher interest rates. For farm borrowers, higher interest rates meant higher costs of carrying debt, which in turn meant reduced cash flows. Under these circumstances, some operators found qualifying for commercial credit more difficult and ended up at the FmHA.

The 1980s have also seen a deep farm recession and a mounting farm debt crisis—developments that have created significant pressure to keep a line of federal credit open to financially ailing farmers. This pressure has been intensified by the large number of troubled accounts that commercial banks and agencies of the Farm Credit System (FCS) have referred to the FmHA. Agricultural banks in the Tenth Federal Reserve District, for example, referred an historically high percentage of borrowers to other credit agencies in 1985, including the FmHA. Likewise, the FCS is referring more farm borrowers to the FmHA in an effort to strengthen its own loan portfolio.

One congressional response to the mounting demand for FmHA credit in the 1980s was the Emergency Agricultural Credit Act of 1984. Contradicting calls by some in Congress for FmHA lending to be scaled back, the act increased loan limits for farm operating loans and extended the repayment period for rescheduled loans. For emergency disaster loans, the application period was extended.

The past ten years have seen a variety of factors contribute to a fourfold increase in FmHA farm loans. Soft farm commodity markets, generous legislation, and farmers' willingness to borrow heavily in the late 1970s, then banking deregulation and a severe farm recession in the 1980s were all factors that led to greater demand for FmHA farm loans. This growth is especially troubling now that balancing the federal budget is a national priority, as the FmHA depends upon congressional appropriations to subsidize low-interest loans and compensate for loan losses. But even the rapidly expanding size of the FmHA's farm loan portfolio is not nearly as worrisome as the deteriorating performance of that portfolio.

[7] Peter J. Barry, "Needed Changes in the Farmers Home Administration Lending Programs," *American Journal of Agricultural Economics*, May 1985, p. 342.

Deteriotating performance of the farm loan portfolio

The deteriorating quality of FmHA farm loans is reflected in both loan delinquencies and loan losses. Delinquencies as a percentage of total FmHA loans have risen substantially, and the outstanding principal represented by delinquencies has also risen. As a result, the FmHA has experienced a dramatic surge in loan losses.

Loan delinquencies

As the amount of farm debt held by the FmHA has increased over the past ten years, so have delinquencies. FmHA farm loan delinquencies grew 40 times between 1976 and 1986, rising from $164 million to $6.8 billion. Ten years ago, just 3 percent of FmHA farm loans were delinquent. Delinquencies now amount to 29 percent of total FmHA farm loans (Chart 4). Likewise, about a fourth of the FmHA's 270,000 farm borrowers are delinquent. One reason for the mounting delinquencies is that, as a lender of last resort, the FmHA has a loan portfolio dominated by highly leveraged borrowers. The average FmHA farm borrower in 1985 had a debt-asset ratio of 80 percent. Severe cash flow problems often plague these heavily indebted borrowers, creating a rising tide of loan delinquencies.

As delinquencies have increased, so has the outstanding principal they represent. The principal outstanding on delinquent loans was nearly $13 billion in 1986—about half the total value of FmHA's farm loan portfolio. Even more disturbing, three-quarters of the delinquent loans were delinquent three or more years. The emergency disaster loan program has contributed the most to this problem. Nearly 90 percent of the delinquencies in that program are over three years old (Chart 5). According to the FmHA, borrowers that are delinquent in their loans more than three years are not likely to catch up on their payments. Their loans will probably end in forfeiture or foreclosure.

TABLE 1
FmHA farm loan delinquencies: top ten states on June 30, 1986

State	Millions of dollars
Georgia	$747.4
Texas	653.8
Mississippi	630.5
California	419.3
Louisiana	359.7
Arkansas	295.3
Minnesota	213.6
Oklahoma	209.9
Florida	199.3
Missouri	194.9
Total - 10 states	$3,923.7
Total - 50 states	$6,786.7

Source: General Accounting Office

States with the largest dollar amounts of delinquent farm loans are in the South and Southeast (Table 1). This concentration likely reflects the role the FmHA assumed as an agricultural lender in those regions in the late 1970s. Three states—Georgia, Mississippi, and Texas—account for nearly a third of all farm loan delinquencies. Three-quarters of the delinquencies in these states are on emergency disaster loans. These three states also account for well over a third of the loans that are delinquent three years or more.

Loan losses

The bottom line in evaluating the performance of the FmHA's loan portfolio is the amount of loan losses. When a borrower defaults on a loan, whether a direct loan or a guaranteed loan, the FmHA loses the amount of the borrower's principal that is not covered by the sale of loan col-

CHART 4

FmHA farm loan delinquencies as a percentage of total loans

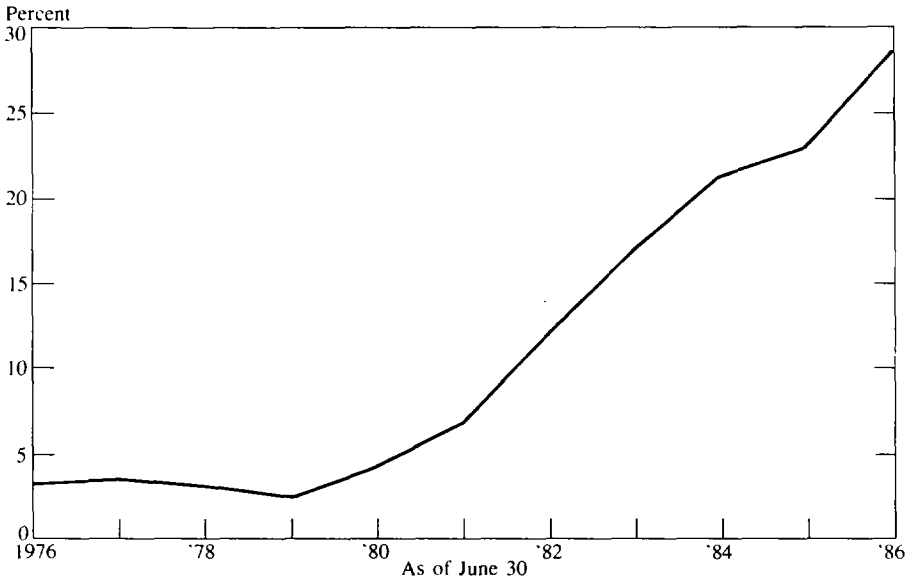
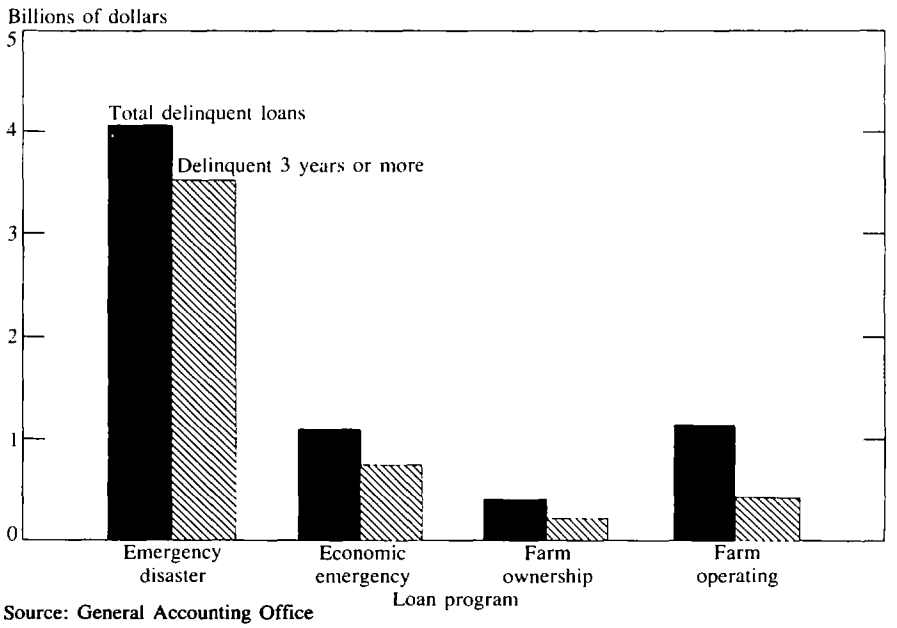


CHART 5

Loan delinquencies by FmHA farm program, 1986



Source: General Accounting Office

lateral. At the end of fiscal 1985, the FmHA had lost $1 billion on direct and guaranteed loans since 1976. A third of those losses were in 1985 alone. Moreover, between 1976 and 1985, loan losses increased 13 times, from $25 million to $354 million (Chart 6). Ninety-five percent of these losses were on direct loans.

Direct loans in two farm programs have been responsible for three-quarters of the FmHA's farm loan losses over the past ten years. Emergency disaster loans account for nearly half the FmHA's loan losses since 1976. Economic emergency loans account for another 23 percent (Chart 7). Regardless of the programs that are most responsible, however, the magnitude of the loan delinquencies and loan losses the FmHA faces establishes a clear need for actions to stem the mounting problems.

Possible program directions

At least two efforts have been made in the past few years to address the FmHA's problem loans. One has been the use of farm foreclosures. The other has been credit provisions of the Food Security Act of 1985 designed to improve the performance of the FmHA's farm loan portfolio and scale back the level of FmHA farm lending. In addition to these measures, several other possible actions could be taken to moderate FmHA lending and improve the quality of its farm loans.

Recent actions

Foreclosure. Early in the current period of farm financial stress, the FmHA began foreclosing on seriously delinquent loans. Many borrowers reacted swiftly, however, by suing to stop the foreclosures. In late 1983, a federal court imposed a nationwide moratorium on almost all FmHA foreclosures.[8] The moratorium lasted 26 months.

When the foreclosure moratorium expired in early 1986, the FmHA began notifying delinquent borrowers that they had to take action to settle their accounts. Delinquent borrowers were required to arrange with their county FmHA officials for debt consolidation, rescheduling, reamortization, set-aside, or deferral. Borrowers who did not respond to the FmHA notification face foreclosure if their loans are delinquent three or more years. Even through foreclosure, however, the FmHA is only partially compensated for the outstanding principal of the loan.

Food Security Act. The Food Security Act provides for a phased shift from direct FmHA loans to loan guarantees. For farm operating and farm ownership loans, there will be a phased shift from equal division between direct and guaranteed loans in 1986 to one-fourth direct loans, three-fourths guaranteed loans in 1988. Under this provision, the FmHA comes closer to being a lender of last resort while sharing more of the credit risk with private lenders.

The act also scales back the emergency disaster loan program. These loans will be capped at $600 million by fiscal 1988. The loans are also no longer available for farms larger than family-sized operations or for losses that could have been covered by crop insurance. Many agricultural economists have long recommended that federal crop insurance against natural disasters be substituted for federal loans.[9] Since natural disaster emergency loans have accounted for nearly half the FmHA's loan losses in the past ten years, and these loans account for more than half the current farm loan

[8] Although some have argued that the foreclosure moratorium did nothing but "postpone the problem," during its period of effectiveness a "homestead provision" was incorporated into the Food Security Act of 1985. Under this provision, an FmHA borrower that loses his farm through foreclosure can lease back his home and five acres, with an option to buy after five years.

[9] See, for example, John E. Lee, Stephen C. Gabriel, and Michael D. Boehlje, "Public Policy Toward Agricultural Credit," *Future Sources of Loanable Funds for Agricultural Banks*, proceedings from a symposium sponsored by the Federal Reserve Bank of Kansas City, December 8-9, 1980, p. 105.

CHART 6

Annual loan losses in FmHA farm programs

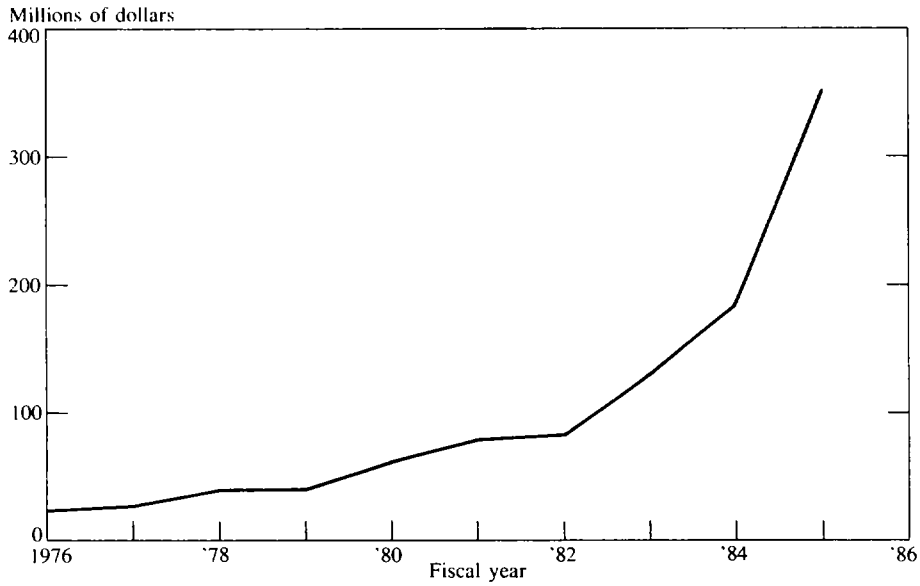
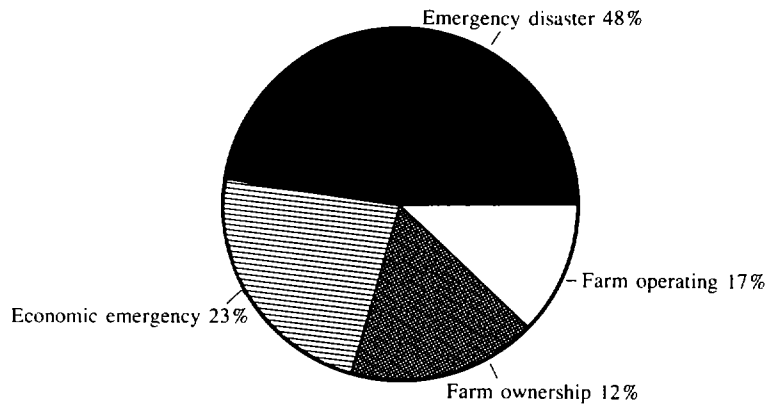


CHART 7

Composition of FmHA farm loan losses

Cumulative for fiscal years 1976 to 1985



Source: General Accounting Office

delinquencies, scaling back these loans should prevent them from causing more serious problems in the future.

Finally, the Food Security Act includes an interest rate buydown program that allows the federal government and private lenders to share in the cost of reducing interest rates on FmHA guaranteed loans. Under this program, lenders can make or refinance loans to eligible farmers at interest rates reduced as much as four percentage points. The commercial lender absorbs half the lost revenue from the reduced rates and the FmHA reimburses the lender for the other half. Thus, while the program involves some short-term costs, it provides farm borrowers a chance to stay in business and lenders a chance to strengthen their agricultural loan portfolios. The program also makes FmHA loan guarantees more attractive than its direct loans. This change is significant since nearly all the FmHA's loan losses in the past ten years have been on direct loans.

Possible actions

Although the Food Security Act took steps to slow the growth in FmHA lending and strengthen its farm loan portfolio, other actions could also be taken. Some of these actions would have an immediate effect, while others would work over the long term.

To improve the quality of its farm loan portfolio in the short term, the FmHA could sell some of its problem loans to private lenders, possibly at auction. Coincidentally, Congress recently proposed that the FmHA sell some of its rural community program loans to raise revenue to meet the fiscal 1987 Gramm-Rudman-Hollings deficit target. Any sale of FmHA's problem farm loans would aim to minimize current and future losses, not raise revenues. There is currently no public proposal to sell the FmHA's farm loans, nor has such a sale ever occurred in the past. Even if such a sale were to be considered at some future time, there would be serious questions about its feasibility. As farm loans would be carefully evaluated by potential purchasers, the worst-performing loans probably could not be sold. Many of these would become loan losses for the FmHA. Other problem loans might be sold at a discount, with the purchaser assuming the risk of loss. The best-performing loans might be sold at little or no discount. Thus, even if the FmHA decided to sell its problem farm loans, it would still incur losses on the loans sold at discount and the loans that did not sell. Therefore, part of any decision to sell problem farm loans would need to include a study of how much the FmHA could expect such sales to reduce its losses.

A longer term action to improve the performance of the FmHA's farm loan portfolio would be an even more pronounced shift from direct loans to loan guarantees. As noted earlier, performance of loan guarantees has been superior to direct loans, with direct loans accounting for nearly all loan losses over the past ten years. Although a shift to loan guarantees was initiated by the Food Security Act, the initiative appeared to be in jeopardy in early 1986, when some members of Congress called for loan guarantee funds to be transferred to direct operating loans for spring credit needs. Ultimately, the funds were not transferred. Instead, $700 million was transferred from the emergency disaster loan fund to direct farm operating loans. Despite this outcome, the episode illustrates the continued preference of farm borrowers for direct loans and the political pressure for direct loans over loan guarantees. For the shift away from direct loans to succeed, a fundamental change is needed in the attitudes of both bankers and borrowers.

Another longer term action to reduce future problems with the FmHA's farm loan portfolio is the use of fixed-term loan guarantees. Under a fixed-term loan guarantee, the FmHA would bear most of the risk in the early life of a loan, while private lenders would bear more as the loan

matured.[10] Because such an arrangement would force private lenders to be more selective in their initial lending decisions, the change would more effectively target assistance to operators that are most likely to achieve financial stability.

Finally, it needs to be resolved whether the FmHA—as the farm lender of last resort—is obliged to lend to all farm borrowers, regardless of their potential for becoming economically viable. For some farmers, financial stress cannot be relieved with more credit. It can be relieved only with a larger income stream, and continued borrowing does not necessarily mean that enough income will be generated. Agricultural lenders are aware of this. So are farm borrowers.

The difficulty arises in situations where farm borrowers may perceive FmHA loans not as credit but as a sort of income transfer. Evidently, some farmers still view the FmHA in terms of its 1930s mission as a provider of income subsidies. The FmHA needs to shed this image. If it does not, it will necessarily continue to suffer delinquent loans and loan losses. The current administration's Debt Assistance Program, effective for one year after its September 1984 announcement, represented a step in this direction. To qualify for assistance under this program, farm borrowers had to show that debt set-asides or loan guarantees would generate a sustainable positive cash flow for their operations. This requirement—that farm borrowers show some potential for achieving economic viability—needs to be applied to all loan programs. In that way, the FmHA could establish itself as a lending agency and dispel its image as an administrator of federal subsidies.

As the actions discussed here indicate, there are several options available for improving the quality of the FmHA's farm loan portfolio. Of these, a shift from direct loans to loan guarantees is virtually certain. In addition, the administration is encouraging the FmHA to change its image by lending only to farmers with operations that have potential for becoming financially sound. The future of other actions, however, depends on the health of the farm economy and the resulting political pressure for or against further steps to rectify the FmHA's loan problems.

[10] Under a fixed-term loan guarantee, the FmHA would back the loan for a fixed number of years, with the proportion of the loan guaranteed diminishing over time. For example, the FmHA might guarantee 90 percent of a loan in year one, diminishing to 10 percent in year nine.

Summary

Although the FmHA performs an important role as a farm lender of last resort, the deteriorating performance of the agency's farm loans suggests that new program directions may be needed. The amount of farm debt held by the FmHA has grown rapidly over the past ten years. Moreover, because FmHA's loan portfolio is characterized by highly leveraged, financially weak borrowers, the agency's loan delinquencies and loan losses are also on the rise.

In view of the deteriorating quality of its farm loans, the FmHA has already begun to move in some new directions. Delinquent borrowers face the possibility of foreclosure, and the Food Security Act has shifted the lending emphasis from direct loans to loan guarantees and scaled back the emergency disaster loan program. Some other steps also could be taken. Selling some of its problem loans to private lenders would immediately improve the FmHA's farm loan portfolio. The feasibility of such a sale remains quite uncertain, however. To prevent future problems, the FmHA might consider using fixed-term loan guarantees. It also needs to follow through in shifting its lending emphasis from direct to guaranteed loans. Finally, even a lender of last resort needs to apply sound standards to its borrowers so that credit is extended to operators with the potential for becoming economically viable and creditworthy with commercial lenders.

Interest Rates and Exchange Rates—What is the Relationship?

By Craig S. Hakkio

During much of the 1970s, U.S. interest rates and the foreign exchange value of the dollar moved in opposite directions. This relationship was particularly pronounced from 1976 to 1979, when short-term interest rates doubled, while the trade-weighted value of the dollar fell 17 percent. In the 1980s, however, the relationship between interest rates and the exchange rate appears to be considerably different. Indeed, for much of this period, U.S. interest rates and the value of the dollar have been positively correlated.

A key question is whether the apparent change in the relationship between interest rates and exchange rates represents a significant structural change in their linkages or whether the change in the relationship can be explained by using standard economic models. The answer to this question has important implications for policymakers. Interest rates and exchange rates are crucial elements in the transmission of monetary and fiscal policy actions to economic activity. If the channels through which policy actions affect the economy have been altered, policymakers may find the design of policy to be more difficult and the consequences of policy actions more unpredictable. Thus, models of interest rate and exchange rate linkages that worked well during the 1970s may not be appropriate in the 1980s.

This article argues that much of the apparent instability in the interest rate-exchange rate relationship can be readily explained in terms of standard economic models. The change from a negative correlation between interest rates and exchange rates in the 1970s to a positive correlation in the 1980s is due to changes in the relative importance of factors underlying interest rate and exchange rate movements. Thus, changes in inflation and expected inflation were the dominant influences causing high interest rates and a lower dollar in the 1970s. In the 1980s, in contrast, changes in real interest rates have been the dominant factor responsible for the positive correlation between interest rates and the dollar.

The article is divided into four sections. The first section briefly reviews recent interest rate

Craig S. Hakkio is a senior economist at the Federal Reserve Bank of Kansas City. J. Gregg Whittaker, assistant economist at the bank, assisted in the preparation of the article.

and exchange rate movements. The next section discusses the fundamental determinants of interest rates and exchange rates. The third section reviews the linkages between interest rates and exchange rates and shows how they can be positively or negatively correlated. The final section applies this analysis to interpreting the behavior of interest rates and the dollar over the 1974-86 period.

Interest rates and exchange rates: the evidence since 1974

The changing relationship between interest rates and the value of the dollar is illustrated in Chart 1. The interest rate used in this chart is the 10-year constant maturity Treasury bond rate. The exchange rate is the effective exchange rate—a weighted average of ten bilateral exchange rates between the dollar and other major currencies. The data in the chart have been smoothed to remove the influence of short-run factors and to highlight basic trend behavior.[1]

As shown in Chart 1, interest rates and exchange rates appear to have been negatively correlated in the 1970s. From 1975 to 1977, for example, interest rates fell while the dollar rose. Then, from 1977 to 1980, while interest rates rose sharply, the value of the dollar declined.

The basic relationship between interest rates and the dollar appears to have changed in the 1980s, however. As the chart shows, during the 1980-81 period, interest rates and the dollar moved in the same direction rather than in opposite directions; interest rates and the dollar trended upward, after abstracting from the sharp movement in interest rates in 1980 due to credit controls. In 1982, however, the relationship reverted to the 1970s pattern, with a drop in interest rates associated with a rising dollar. Then, from 1983 to 1986, a positive correlation reappeared and interest rates and the dollar again moved up and down together.

Chart 1 shows that there is no simple relationship between interest rates and the dollar. This does not imply, however, that the relationship is unstable or that the structure of the relationship broke down in the 1980s. As argued in the following sections, much of the behavior of interest rates and exchange rates over the 1974-86 period can be explained by the behavior of their underlying determinants.

Determinants of interest rates and exchange rates

The interest rate and exchange rate shown in Chart 1 are rates quoted in financial markets, that is, they are nominal rates. To understand their behavior over the 1974-86 period, it is useful to distinguish between real and nominal interest rates and between real and nominal exchange rates. This section develops this distinction and identifies common factors affecting interest rates and exchange rates.

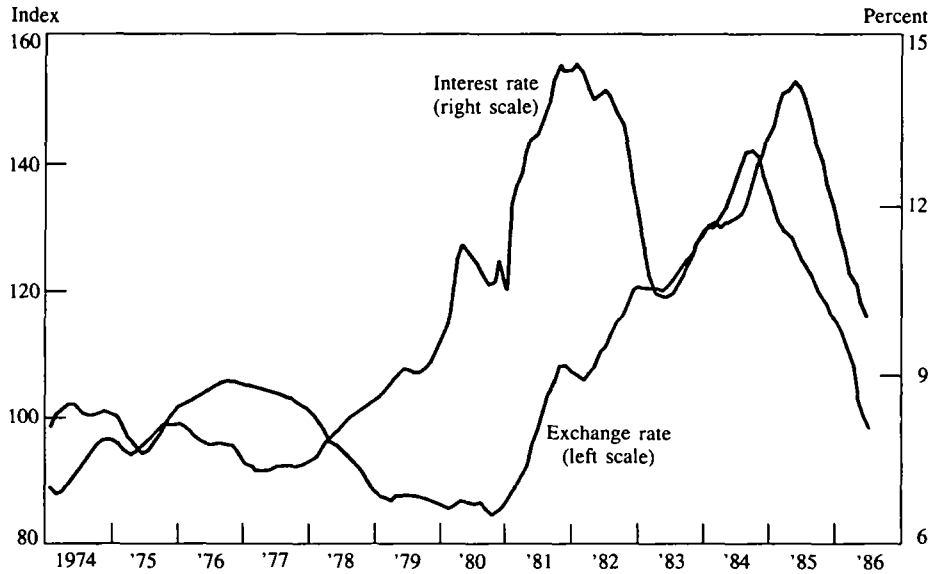
Real and nominal interest rates

The distinction between real and nominal interest rates has become familiar in analyses of inflation during the 1970s. While the nominal interest rate is the rate quoted by banks and the

[1] The exchange rate is the effective exchange rate—a weighted average of ten bilateral exchange rates with Germany, Japan, France, the United Kingdom, Canada, Italy, the Netherlands, Belgium, Sweden, and Switzerland. The long-term U.S. interest rate is the 10-year constant maturity U.S. Treasury bond rate. The data in Charts 1-5 have been smoothed, to reduce the influence of short-run factors. A six-month moving average was used to smooth the data: if x_t equals the original data, and s_t equals the smoothed data, then $s_t = (x_t + x_{t-1} + \ldots + x_{t-5})/6$. The discussion in the text refers to the smoothed data and not the original data. Smoothing the data usually causes the peaks and troughs to occur later than with the original data. In Chart 1, for example, the exchange rate peaks in June 1985, but in the original data the peak occurs in February 1985. Using the 3-month CD rate produces a similar chart.

CHART 1

U.S. long-term interest rate and the exchange rate



Source: Board of Governors of the Federal Reserve System

financial press, the real rate adjusts the nominal rate for the influence of inflation. According to the "Fisher equation," the nominal interest rate i is equal to the real interest rate r plus the expected rate of inflation p^e:

$$(1) \quad i = r + p^e.$$

Thus, for example, when a lender receives a 10 percent nominal interest rate but expected inflation is 7 percent, the real interest rate is only 3 percent.[2] Although the lender receives 10 percent more dollars, he can buy only 3 percent more goods and services because inflation has increased the price of goods and services.

In this framework, nominal interest rates change either because of a change in the underlying real rate of interest or because of a change in expected inflation. For example, nominal interest rates could increase because of an increase in the real rate, with no change in expected inflation. Similarly, nominal interest rates could decline because of a decline in inflationary expectations, with no change in the real rate. A number of factors can cause variation in the underlying real rate or expected rate of inflation.

The real rate of interest is determined by the demand for and supply of funds in the economy. The supply of funds in the domestic economy comes from the saving of individuals and firms plus funds provided by the banking system. The demand for funds comes from firms making investment decisions, consumers borrowing in excess of current income, and government financing a budget deficit. In an open economy, other

[2] The tax deductibility of interest payments changes this statement slightly, but the basic concepts are the same.

countries may provide an additional net demand for or supply of funds.

The real interest rate tends to rise or fall as the demand for funds grows faster or slower than the supply of funds. The demand for funds increases, for example, if the government borrows to finance an increase in the deficit.[3] The government's increased demand for funds crowds out private investors, driving up the real interest rate. By paying a higher real interest rate, the government ensures that it, rather than others, obtains the funds it needs. In this way, an increase in the demand for funds puts upward pressure on the real interest rate.

Expectations of inflation can also change for several reasons. On the one hand, such special factors as one-time changes in the price of energy or food can have a temporary effect on the inflation rate. Since this shock may take several years to work its way through the economy, expectations of inflation can be affected for some time even though the shock has no permanent effect on the inflation rate. On the other hand, inflation expectations can change because of events leading to a continuously rising or falling price level. Such an effect might be associated with an excessive or deficient rate of money growth.

Real and nominal exchange rates

While the concept of the real interest rate has been widely discussed in recent years, the concept of a real exchange rate may be somewhat less familiar. As in the case of interest rates, however, the distinction between a nominal exchange rate and a real exchange rate makes it possible to distinguish real or relative price effects from changes in the general price level.

The nominal exchange rate quoted in the financial press is the price of the dollar in terms of foreign currency. For example, the exchange rate between the dollar and the Japanese yen might be quoted as 160 yen per dollar. In contrast, the real exchange rate is not a rate of currency exchange. Rather, it is the relative price of U.S. goods in terms of foreign goods. As such, the real exchange rate reflects the underlying terms of trade between U.S. and foreign goods.

Equation 2 shows the relationship between the nominal exchange rate and the real exchange rate:

$$(2) \quad e = q\ P^*/P.$$

In this equation, e is the nominal exchange rate, q is the real exchange rate, P is the U.S. price level, and P* is the foreign price level. The nominal exchange rate, e, can be viewed either as the price of the dollar in terms of foreign currency or, equivalently, as the foreign price of U.S. goods relative to the dollar price of U.S. goods.[4] In contrast, the real exchange rate, q, is the price of U.S. goods in terms of foreign goods. Rearranging equation 2, it can be shown that the real exchange rate is simply the nominal exchange rate deflated by the ratio of foreign to domestic prices ($q = e/[P^*/P]$).

From equation 2, it is clear that the nominal exchange rate can change either because of a change in the real exchange rate or because of a change in the general price levels in the United States or abroad. An increase in the real exchange

[3] Some have argued that the federal budget deficit also leads to an equal increase in the amount of savings, since individuals take into account the future tax liabilities associated with the budget deficit. Others, however, believe that the supply of funds does not increase equally, so that there is a net increase in the demand for funds. For a discussion of these arguments and a review of the empirical evidence, see Charles Webster, "The Effects of Deficits on Interest Rates," *Economic Review*, Federal Reserve Bank of Kansas City, May 1983, pp. 19-28.

[4] For further elaboration on the determinants of the nominal exchange rate, see Craig S. Hakkio, "Exchange Rate Volatility and Federal Reserve Policy," *Economic Review*, Federal Reserve Bank of Kansas City, July/August 1984, pp. 18-31.

rate or the foreign price level causes the nominal exchange rate to appreciate, while an increase in the domestic price level causes the nominal exchange rate to depreciate.

A variety of factors can cause the real exchange rate to change. For example, there may be a change in tastes away from domestically produced goods to foreign goods. Suppose that Japanese consumers decide to buy more U.S. goods rather than domestic products. This shift in demand will tend to raise the relative price of U.S. goods, leading to a rise in the real exchange rate. Then, if domestic and foreign price levels do not change, the nominal exchange rate will also rise. The reason is that since Japanese consumers need more dollars to purchase U.S. products, they will sell yen and buy dollars, causing the foreign exchange value of the dollar to increase.

Another reason for changes in real exchange rates comes from international investment and savings decisions. In addition to buying U.S. goods, Japanese investors might buy U.S. financial assets. A decision to buy more U.S. assets could result from the view that the real return on U.S. assets exceeds the real return on comparable Japanese assets. If Japanese investors buy more U.S. assets, the real exchange rate will rise. Since this decision requires the purchase of additional dollars in the foreign exchange market, the nominal exchange rate will also appreciate.

Changes in domestic and foreign price levels are the second factor influencing nominal exchange rates. Equation 2 shows that exchange rate movements are influenced by differences in foreign and domestic price levels. When prices in the United States rise faster than prices abroad, the nominal exchange rate depreciates because foreigners reduce their purchases of more expensive U.S. goods and thus reduce their demand for dollars in foreign exchange markets. In contrast, when foreign prices rise faster than U.S. prices, the nominal exchange rate appreciates because U.S. citizens tend to import fewer of the more expensive foreign goods. As a result, the demand for foreign currencies falls and the foreign exchange value of the dollar rises.

The linkages between interest rates and exchange rates

The preceding section identified key factors underlying the behavior of nominal interest rates and exchange rates. This section examines the channels linking interest rate and exchange rate movements and shows how changes in the relative importance of the underlying factors can result in patterns of positive or negative correlation between interest rates and exchange rates.

Inflation effects on interest rates and exchange rates

One simple channel linking interest rates and exchange rates is through the effects of inflation. Since nominal interest rates depend on expected inflation while nominal exchange rates depend on relative rates of foreign and domestic inflation, an inflation shock will affect both nominal interest rates and exchange rates.

Inflation shocks can usually be expected to lead to a negative correlation between nominal interest rates and exchange rates. Suppose, for example, that an increase in the price of energy or faster money growth leads to an increase in U.S. inflation. To the extent that higher inflation is built into inflation expectations, nominal interest rates in the United States will tend to rise. And, if U.S. inflation exceeds foreign inflation, the nominal exchange rate will tend to fall.

Similarly, disinflationary policy could lead to a negative relationship between interest rates and exchange rates. A reduction in U.S. inflation that led to lower inflation expectations would tend to reduce nominal interest rates in the United States. And, if the U.S. inflation rate is lower than foreign inflation rates, U.S. products would

become more attractive in international markets and the dollar would tend to appreciate.

Real effects on interest rates and exchange rates

Nominal interest rates and exchange rates are also linked through movements in real interest rates. As discussion of the Fisher relationship showed, changes in real interest rates are translated directly into changes in nominal interest rates. In addition, changes in real interest rates, by altering the relative attractiveness of domestic and foreign investment opportunities, cause movements in real and nominal exchange rates.

To see the connection between real interest rates and the exchange rate, consider a foreign investor with a choice of investing in U.S. or domestic assets. The choice depends partly on a comparison of relative real interest rates. But because assets in different countries are denominated in different currencies, changes in the real exchange rate also affect the relative returns. Any expected appreciation of the real value of the dollar represents an expected capital gain and adds to the U.S. real return. Likewise, any expected depreciation of the real value of the dollar represents a capital loss and lowers the U.S. real return.

Generally, market forces should equalize the real returns to investment in the two countries. As a result, the real return to investment in the United States—the U.S. real interest rate plus the expected appreciation of the real exchange rate—should equal the foreign real interest rate:

$$\text{(3)}\quad \begin{matrix}\text{U.S. real}\\ \text{interest}\\ \text{rate}\end{matrix} + \begin{matrix}\text{expected}\\ \text{appreciation}\\ \text{of real}\\ \text{exchange rate}\end{matrix} = \begin{matrix}\text{foreign real}\\ \text{interest}\\ \text{rate}\end{matrix}$$

That is, if the U.S. real interest rate is higher than the foreign real interest rate, the market must be expecting the real exchange rate to depreciate. In this way, the expected depreciation of the real exchange rate offsets the higher U.S. real interest rate and the total U.S. real return equals the foreign real return. Viewed differently, the expected appreciation or depreciation of the dollar is directly related to the real interest rate differential in the two countries.

In this framework, an increase in the U.S. real interest rate will lead to an increase in the real exchange rate and the nominal exchange rate. A higher U.S. real interest rate increases the attractiveness of U.S. assets, leading to an increase in the demand for dollar-denominated assets and an appreciation of the real exchange rate. Then, for given price levels at home and abroad, the nominal exchange rate also tends to rise.

There is another way to see that an increase in the U.S. real interest rate leads to an increase in the real exchange rate. Because the total real return in the United States must equal the foreign real interest rate, as shown in equation 3, a rise in the U.S. real interest rate relative to the foreign real interest rate must lead to an expected depreciation of the real exchange rate. Therefore, if the real exchange rate is assumed to be constant in the long run, the only way for the market to expect the real exchange rate to depreciate in the future is for the real exchange rate to appreciate today. That is, an increase in the real interest rate leads to an increase in the current real exchange rate and an expected depreciation of the real exchange rate. As William Branson put it, "What must go down in the future [an expected depreciation], must go up today [the current real exchange rate]."[5]

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[5] See William H. Branson, "Causes of Appreciation and Volatility of the Dollar," *The U.S. Dollar—Recent Developments, Outlook, and Policy Options*, proceedings of a conference sponsored by the Federal Reserve Bank of Kansas City, August 21-23, 1985, and Craig S. Hakkio and J. Gregg Whittaker, "The U.S. Dollar—Recent Developments, Outlook, and Policy Options," *Economic Review*, September/October 1985, Federal Reserve Bank of Kansas City, pp. 3-15.

Unlike inflation shocks, real interest rate shocks can be expected to result in a positive correlation between nominal interest rates and exchange rates. A rise in U.S. real interest rates resulting from higher budget deficits, for example, will directly cause a rise in nominal interest rates. In addition, the higher real interest rate in the United States will tend to raise both the real exchange rate and the nominal exchange rate. Similarly, a reduction in real rates in the United States will tend to lower nominal rates in the United States directly. And if the U.S. real interest rate falls relative to foreign real rates, there will be a corresponding fall in the real and nominal value of the dollar.

Interest rates and the exchange rate—explaining the evidence

Chart 1 showed that the relationship between nominal interest rates and the foreign exchange value of the dollar appeared to change in the 1980s. Interest rates and the exchange rate were negatively related until 1980. For most of the period since 1980, however, interest rates and the dollar have tended to move in the same direction.

The preceding section presented a theoretical framework in which inflation and real interest rate shocks can cause different patterns in the interest rate-exchange rate relationship. This section examines data on expected inflation, real interest rates, inflation differentials, and real interest rate differentials to see whether the theoretical framework provides a consistent explanation of the empirical evidence.

Interest rates and exchange rates: 1974 to 1979

According to the analysis presented in this article, the negative relationship between interest rates and the exchange rate during the 1970s, shown in Chart 1, is consistent with the view that inflation shocks dominated interest rate and exchange rate movements. Casual evidence supports this view. Oil and food prices increased dramatically in the early 1970s. After rising only 5 percent in 1972, food prices increased at an annual rate of 15 percent during the first three quarters of 1973. Then, as a result of OPEC, retail energy prices jumped 44 percent from the end of 1973 to the middle of 1974, after rising only 8 percent in the three previous quarters. Inflation rose again in the late 1970s, as food price increases in 1977-79 and oil price increases in 1978-79 occurred during a period of rapid growth in the money supply.

More direct evidence in support of an inflation explanation of interest rate and exchange rate movements can be obtained by looking at their underlying determinants. To the extent that inflation in the United States is built into inflation expectations, nominal interest rates will tend to rise and fall with inflation expectations. Thus, a high positive correlation between nominal interest rates and expected inflation supports the view that real factors were not an important determinant of nominal interest rate changes. If, in addition, there is a strong negative correlation between the dollar and the inflation differential in the United States and abroad, this supports an inflation explanation for exchange rate movements rather than a real explanation.

Chart 2, which plots the U.S. 3-month CD interest rate and a measure of expected inflation, shows that interest rates and expected inflation moved together from January 1974 to December 1979.[6] Both rose in the first three quarters of 1974, fell through the first quarter of 1977, and rose again until the end of 1979. Given the close

[6] The Board of Governors of the Federal Reserve System reports a real interest rate that is comparable with the 3-month CD interest rate. The expected rate of U.S. inflation is defined as the CD interest rate minus the real interest rate.

CHART 2

U.S. interest rates and expected inflation

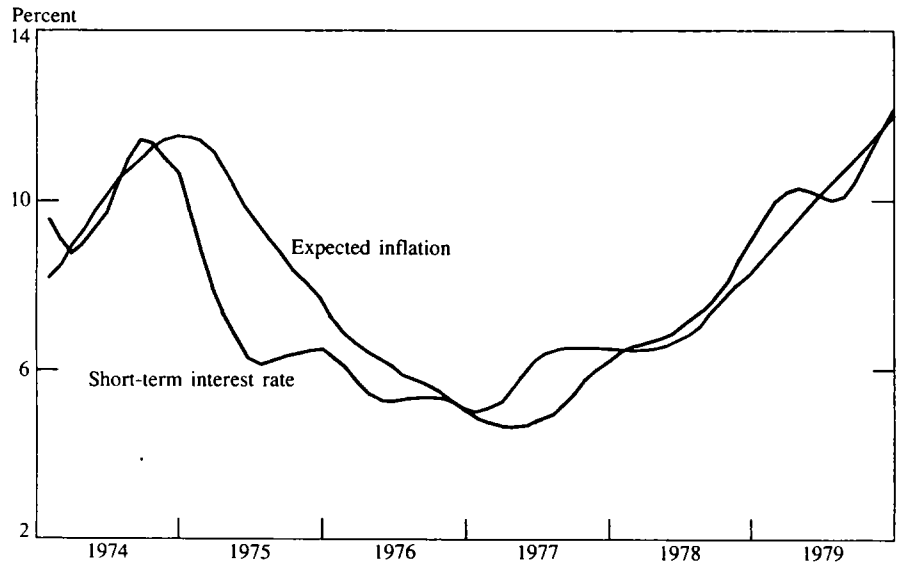
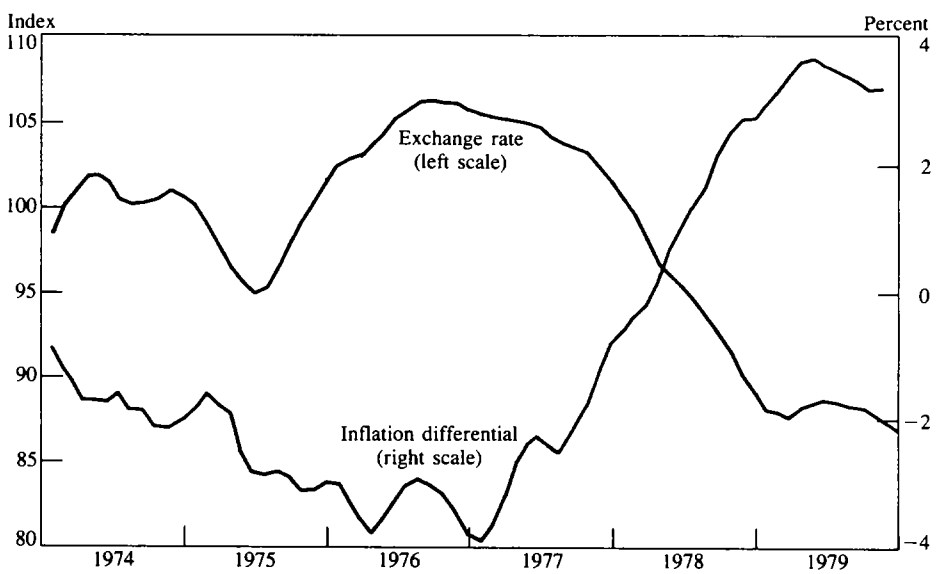


CHART 3

Exchange rate and inflation differential



Source: Board of Governors of the Federal Reserve System

movement of nominal interest rates and expected inflation during this period, most of the changes in the nominal interest rate appear to be due to changes in expected inflation rather than to changes in real interest rates.

Chart 3, which plots the nominal exchange rate and the difference in U.S. and foreign inflation, supports the inflation explanation of exchange rate movements for the period from January 1974 to December 1979.[7] During the 1974-79 period, the nominal exchange rate and the inflation differential moved in opposite directions and were highly correlated. In 1975 and 1976, the inflation differential fell as foreign inflation exceeded U.S. inflation. During this period the dollar rose. Then, from 1977 to 1979, the inflation differential rose as U.S. inflation exceeded foreign inflation and the dollar fell. Thus, inflation factors appear to have dominated real factors in explaining exchange rate movements during this period.

Interest rates and exchange rates: 1980 to 1986

Nominal interest rates and the dollar have been positively correlated during much of the 1980s, as shown in Chart 1. Such a relationship is consistent with the dominance of real rather than inflationary shocks to the economy. At first glance, this dominance might seem puzzling. After all, the 1980s have generally been a period of disinflation, with inflation declining from double-digit rates in the late 1970s to the 3 to 4 percent range in the mid-1980s.

Real factors have been important, however. Real interest rates have been significantly higher in the 1980s than at any other time in the postwar period. The rise in real rates has been attributed to a number of factors: restrictive monetary policy in the 1980-82 period, major changes in tax laws affecting investment spending, an apparent decline in the personal savings rate, and record federal budget deficits.[8]

Again, evidence in support of a real explanation of interest rate and exchange rate movements during the 1980s can be obtained by looking at their underlying determinants. If real factors are important in explaining nominal interest rate movements, real interest rates should have a significant positive correlation with nominal interest rates. Similarly, if real factors are of primary importance in explaining exchange rate movements, there should be a strong positive correlation between the nominal exchange rate and the difference between real interest rates in the United States and abroad.

Chart 4, by plotting the real and nominal 10-year constant maturity bond rate from January 1980 to December 1985, shows that there is a clear positive relationship between nominal and real interest rates over this period.[9] Moreover, since expected inflation declined during most of this period, nominal interest rates should have declined if inflationary factors were dominant.

Movements in the nominal exchange rate and the real interest rate differential, as shown in Chart 5, also tend to support the real explanation of exchange rate movements. From 1980 to mid-1982, the real interest rate differential rose

[7] The Board of Governors reports a foreign weighted average CPI. The foreign rate of inflation equals the percentage change in the foreign weighted average CPI; the U.S. rate of inflation equals the percentage change in the U.S. CPI; the inflation differential equals the U.S. rate of inflation minus the foreign rate of inflation (and is a 12-month moving average).

[8] See Stephen Cecchetti, "High Real Interest Rates: Can They Be Explained?" *Economic Review*, Federal Reserve Bank of Kansas City, September/October 1986, for a discussion of the determinants of real interest rates and an analysis of recent movements in U.S. real interest rates.

[9] The Board of Governors of the Federal Reserve System reports a long-term U.S. and foreign real interest rate. The foreign real interest rate is a weighted average of ten corresponding foreign rates.

CHART 4

U.S. real and nominal interest rates

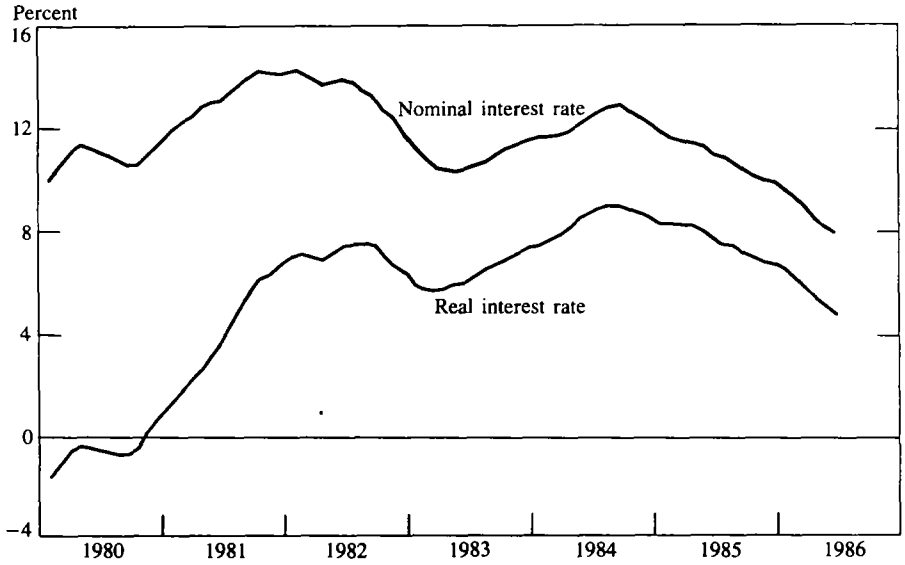
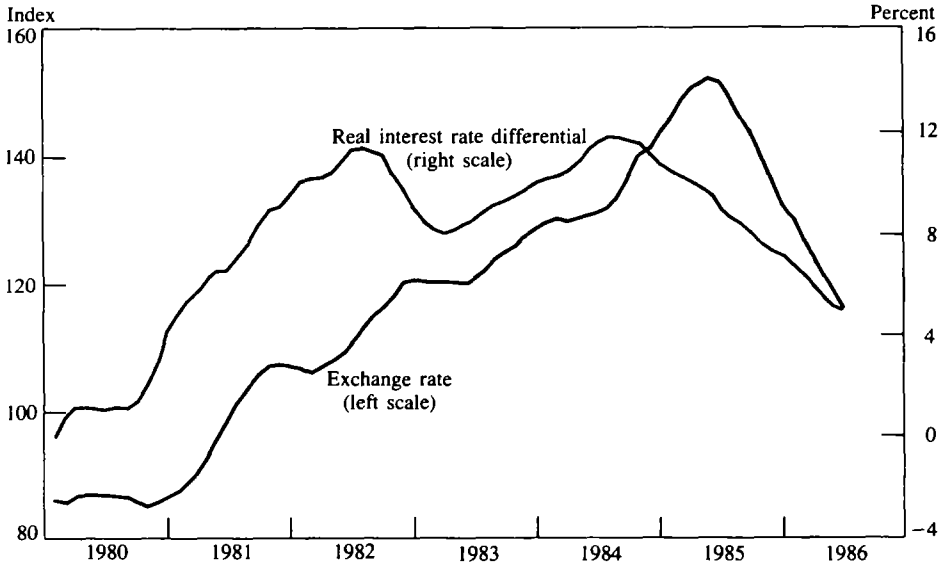


CHART 5

The exchange rate and real interest rate differential



Source: Board of Governors of the Federal Reserve System

as the dollar appreciated. Then, from mid-1983 to late 1984, both the exchange rate and the real interest rate differential increased together. Finally, from mid-1985 to mid-1986, the dollar and the real interest rate differential moved lower. Thus, for most of the 1980-86 period, movements in the real interest rate differential provide a sensible explanation for exchange rate movements.

During two subperiods, however, real factors do not provide a good explanation for exchange rate movements. From July 1982 to March 1983, the exchange rate rose while the real interest differential fell. During that time, however, the inflation differential declined as U.S. inflation fell faster than foreign inflation. Thus, inflation factors seem to provide a better explanation of exchange rate movements during this period. The second subperiod, from September 1984 to May 1985, however, is not easily explained in the framework of this article. During this period, the real interest differential fell while the inflation differential rose. Either of these factors should have caused the dollar to fall. Instead, the dollar rose. Thus, the behavior of the exchange rate during this period does not seem to fit either the real or inflation explanation of exchange rate movements.[10]

Conclusion

This article has sought to explain changes in the relationship between interest rates and exchange rates over the 1974-86 period. In the framework presented in this article, the negative correlation between nominal interest rates in the United States and the dollar during the 1970s is consistent with the view that inflation shocks dominated interest rates and exchange rate movements. In contrast, during the 1980s, the generally positive relationship between interest rates and the dollar is consistent with the view that changes in real interest rates were the dominant influence on nominal interest rates and the dollar.

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[10] See, for example, Richard Meese and Kenneth Rogoff, "Was It Real? The Exchange Rate-Interest Differential Relation, 1973-1974," International Finance Discussion Paper No. 268, Board of Governors of the Federal Reserve System, August 1985.

Economic Review
Federal Reserve Bank of Kansas City
Kansas City, Missouri 64198
November 1986, Vol. 71, No. 9