



A BUSINESS AND FINANCIAL REVIEW BY THE FEDERAL RESERVE BANK OF CHICAGO

May/June 1981

ISSN 0164 - 0682

ECONOMIC

PERSPECTIVES

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ECONOMIC PERSPECTIVES

May/June 1981, Volume V, Issue 3

Economic Perspectives is published bimonthly by the Research Department of the Federal Reserve Bank of Chicago. The publication is produced under the direction of Harvey Rosenblum, Vice President, and is edited by Larry R. Mote, Assistant Vice President, with the assistance of Sandra Cowen (editorial), Roger Thryselius (artwork and graphics), and Nancy Ahlstrom (typesetting). The views expressed in **Economic Perspectives** are the authors' and do not necessarily reflect the views of the management of the Federal Reserve Bank of Chicago or the Federal Reserve System.

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Controlled circulation postage
paid at Chicago, Illinois.

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Interest rates and inflation

John H. Wood*

If a trader has lent wheat . . . at interest, then for every gur of wheat he shall take 100 qa as interest. If he has lent silver at interest, then for each shekel of silver he shall take a sixth part of a shekel, plus six grains, as interest.

*The Hammurabi Code, No. 90,
circa 2080 B.C.*

The relation between interest rates and inflation has attracted much attention in recent years. Serious empirical research on this subject has resumed after a lapse of nearly four decades, from the early 1930s to the late 1960s. The point of departure of this work has been Irving Fisher's classic study, *The Theory of Interest* [5], published in 1930. Fisher found interest rates during the period 1890-1927 to respond slowly and incompletely to variations in inflation. The most common interpretation of these results is that inflationary expectations, which influence current interest rates, respond slowly to observations of past inflation.

The results of most recent studies have been consistent with Fisher's. But Eugene Fama [4] has presented results that contradict those of earlier writers. More important, Fama's work suggests that interest rates immediately and completely reflect inflationary expectations.

This article compares the results of Fisher and Fama and places these results in historical perspective. The small differences between Fisher and Fama appear to be due less to increases in financial market efficiency, improvements in statistical methods, and better data (as suggested by Fama) than to the spe-

cial, relatively tranquil period chosen by Fama for his empirical work.

The years 1953-71 are unique in American history for their record of stable prices. Charts 1 and 2 make clear that there is not, among periods of similar length, a close competitor after 1894 with 1953-71 for the most-stable-price-period prize.

Variations in prices since 1971 have been more like those observed by Fisher than Fama. Therefore, an understanding of the connections between interest rates and inflation in the world in which we live, while not neglecting Fama's contributions, requires that we pay special attention to Fisher's.

Real and nominal interest rates

The distinction between interest rates in terms of money (e.g., silver) and interest rates in terms of goods (e.g., wheat) has long been recognized. It is useful to think of the former as *nominal* rates of interest, R , and of the latter as *real* rates of interest, r . In the United States nominal rates of interest measure returns in dollars. These are the rates of interest reported in newspapers and advertised by depository institutions. Real rates of interest, on the other hand, measure the productivity of investment goods (i.e., the rate of transformation of current goods into future goods) and the time preferences of households (i.e., the allocation of consumption between current and future goods). Differences between real and nominal interest rates ought to be due to expected rates of inflation, i.e., to expected rates of change in the value of money relative to goods. If the expected rate of inflation is denoted p , the equilibrium relation between R and r may be expressed as:

$$(1) \quad (1 + R) = (1 + r)(1 + p).$$

*Written in collaboration with Scott Ulman. We are grateful for helpful comments by George Kaufman, Larry Mote, and Harvey Rosenblum.

Suppose, for example, that the expected real return to an investment in a machine is $r = 3$ percent per annum. That is, the machine is expected to produce a net output each year worth 3 percent of the value of the machine. Further suppose that, due to inflation, the prices of the machine and its output are expected to rise 5 percent during the next year. That is, expected inflation is $p = 5$ percent. The expected nominal (dollar) rate of return to this real investment is therefore $(1.03)(1.05) - 1 = 8.15$ percent. An investor's choice between the machine (or shares in the machine) and, say, a 52-week Treasury bill depends on the bill's yield, or rate of return, R . If R exceeds 8.15 percent, investors will be attracted to the bill, bidding its rate down until R equals the expected return on alternative investments of similar risk, including real investments.¹ If R is less than 8.15 percent,

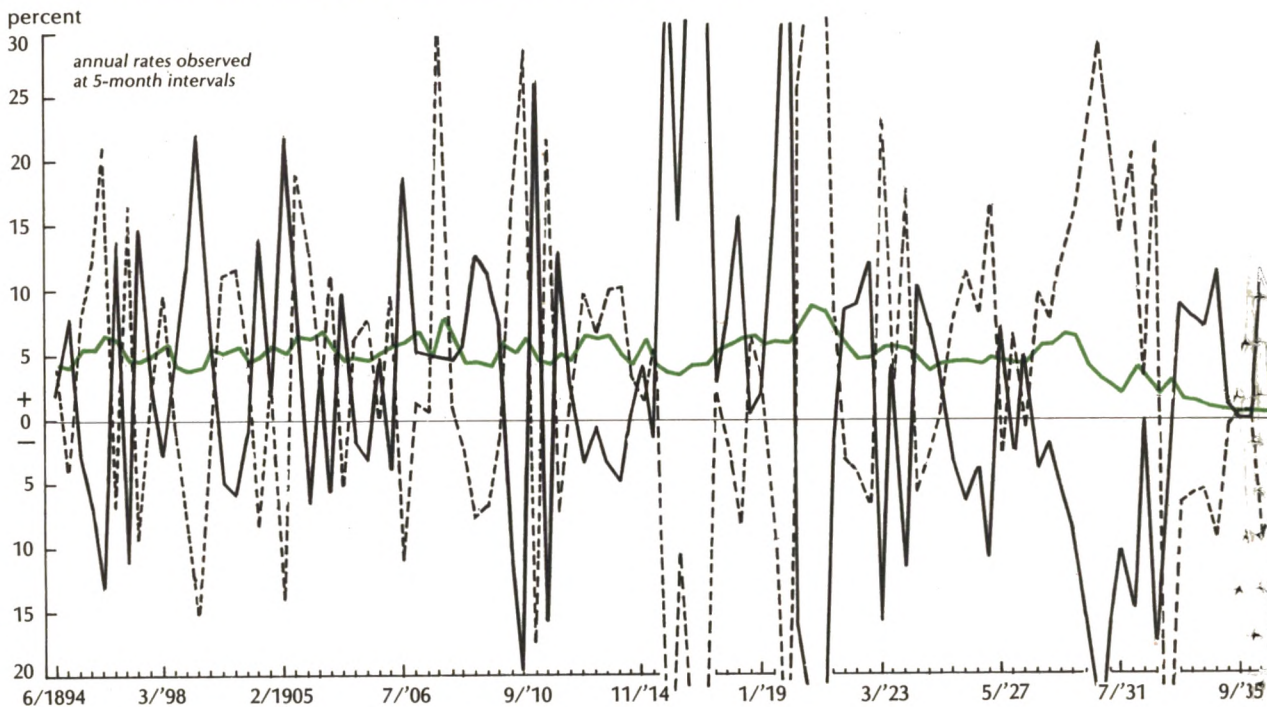
investors will avoid the bill until its rate becomes competitive with other investments. This line of argument suggests that, given $r = .03$ and $p = .05$, the equilibrium value of R is .0815. An alternative but equivalent way of looking at the real rate of interest, the gain in purchasing power from lending money, is presented in box 1.

Under the dubious assumption that the Babylonian bureaucracy fixed interest on silver and wheat at rates compatible with market forces, we can determine the expected rate of change of prices in that country in 2080 B.C. Since 1 gur = 300 qa of wheat and 1 shekel = 180 grains of silver, $r = 100/300 = 33 \frac{1}{3}$ percent and $R = 36/180 = 20$ percent. Using equation (1), we can surmise that Hammurabi's subjects expected an annual rate of deflation of 10 percent.²

¹This argument follows Fisher and Fama in abstracting from complications associated with risk and taxes.

²Unlike paper money, there is a real return to silver in productive activities. For the sake of completeness, therefore, r should be interpreted in our Babylonian example as the difference between the real returns to wheat and silver.

Chart 1. Inflation and real and nominal interest rates



Equation (1) is often expressed as the following linear approximation:

$$(2) \quad R \cong r + p.$$

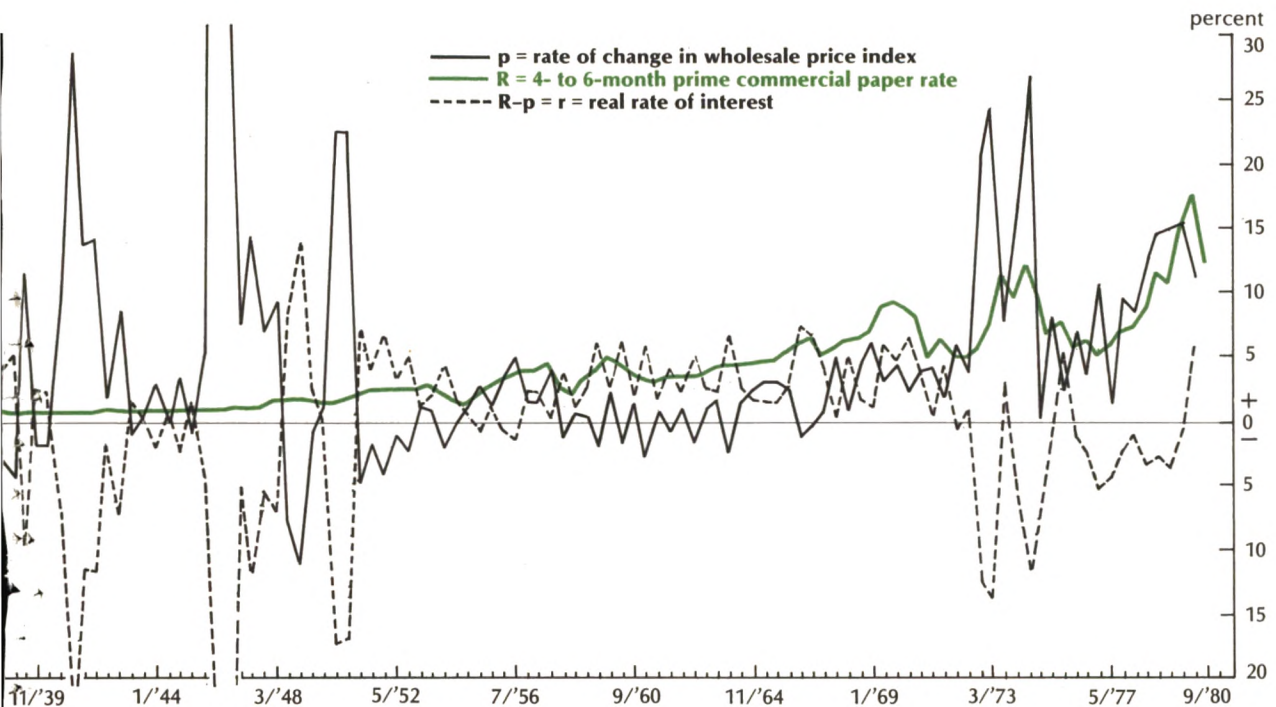
This approximation is fairly close for small p and r . In the two examples given above, the approximate equilibrium nominal rates are 8 and $-23 \frac{1}{3}$ percent, compared with the exact equilibrium values of 8.15 and -20 percent.

Although the connections between interest and inflation have been understood for thousands of years, they have never been discussed more than during the past 250 years. This is due to the increased use of paper money and therefore to the increased volatility of inflation. William Douglass wrote in 1740 that large emissions of paper money “rise the interest to make good the sinking principal [2, p. 335].” For example, the Rhode Island issue of 1739, which caused a depreciation of paper money by 7 percent, required an increase in the rate of interest from 6 to 13

percent. Speaking in the House of Commons in 1811, during a period of wartime inflation, Henry Thornton pointed out that if a man borrowed money at a nominal interest rate of 5 percent and repaid the loan after a period of 2 percent or 3 percent inflation, “he would find that he had borrowed at 2 or 3 percent, and not at 5 percent as he appeared to do [11, p. 336].”

Fisher’s results

The first extensive statistical studies of the relations between real and nominal interest rates and inflation were carried out by Irving Fisher. His results were stated in their most complete form in *The Theory of Interest* [5, pp. 399-451]. Empirical tests of equation (1) are difficult for a variety of reasons. Most important, none of the three variables is directly observable. All are expectations of future events: p is the expected rate of inflation, r is the expected real return to productive activities, and R is the expected nominal



return to investments in debt to be repaid in dollars. Most researchers have simplified the problem by assuming the real return to be constant and by choosing high-grade short-term securities with the same maturity as the period of observation to ensure that observed nominal yields were virtually the same as expected nominal returns. For example, Fisher's most thorough tests used quarterly data and four- to six-month prime commercial paper. This is not a perfect solution to the problem, but later writers have been able to use Treasury bills.

This leaves expected inflation. It is conceivable that the market's expectation of inflation during the period beginning on date t is a weighted average of past inflation rates. Then using the linear approximation (2), our model may be written:

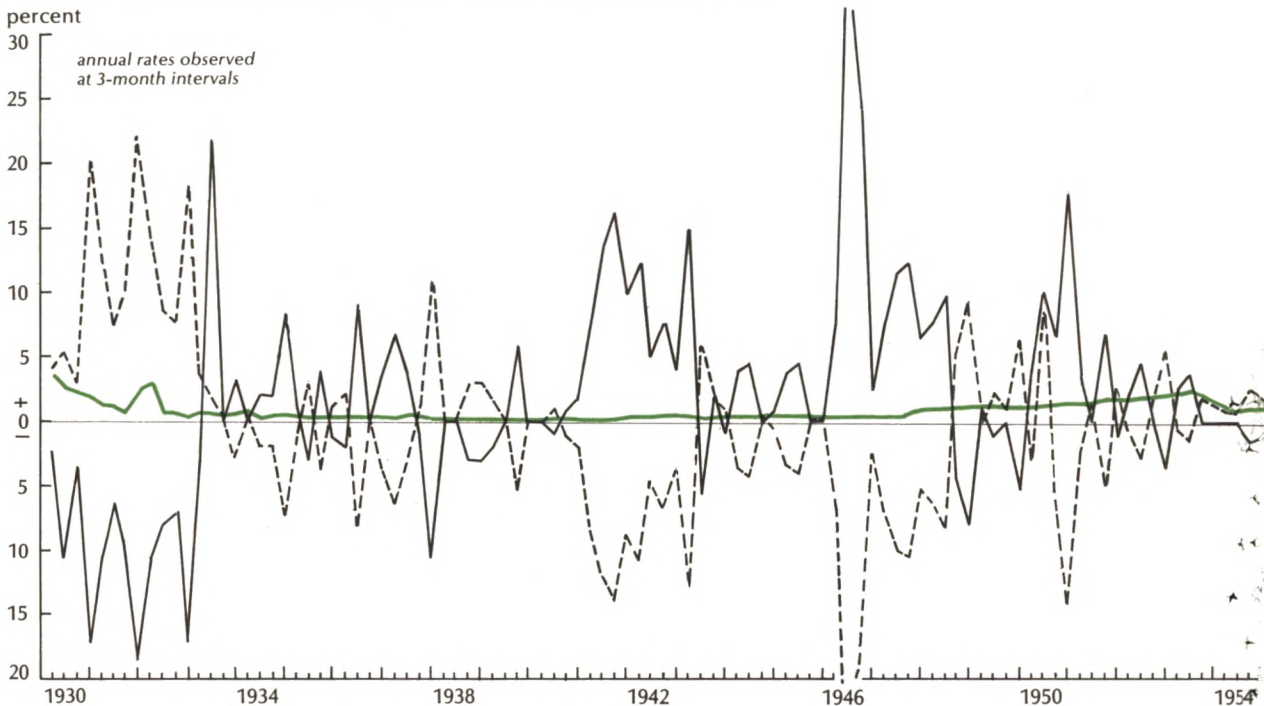
$$(3) \quad R_t = r + w_1 p_{t-1} + w_2 p_{t-2} + \dots + w_n p_{t-n} \\ + e_t = r + \bar{p}_{nt} + e_t$$

where R_t is the yield on date t on a security maturing in one period; the w 's are weights that indicate the importance of past rates of inflation (p_{t-1}, p_{t-2}, \dots) in determining expectations of inflation for the coming period, p_t ; \bar{p}_{nt} is the weighted average of these past rates of inflation, with n being the length of the lag, i.e., the number of past rates included; and e_t is an unobserved random error term with a mean of zero. There is no time subscript on the real rate of interest because it is assumed to be constant.

Fisher did not estimate the w 's. Regressions in those days were too expensive for such a procedure. Rather, he tried different combinations of the w 's and n and ran correlations of the resulting \bar{p}_{nt} 's and R_t . Specifically, his weighting scheme was:

$$(4) \quad \bar{p}_{nt} = \frac{np_{t-1} + (n-1)p_{t-2} + \dots + p_{t-n}}{n + (n-1) + \dots + 1}$$

Chart 2. Inflation and real and nominal interest rates



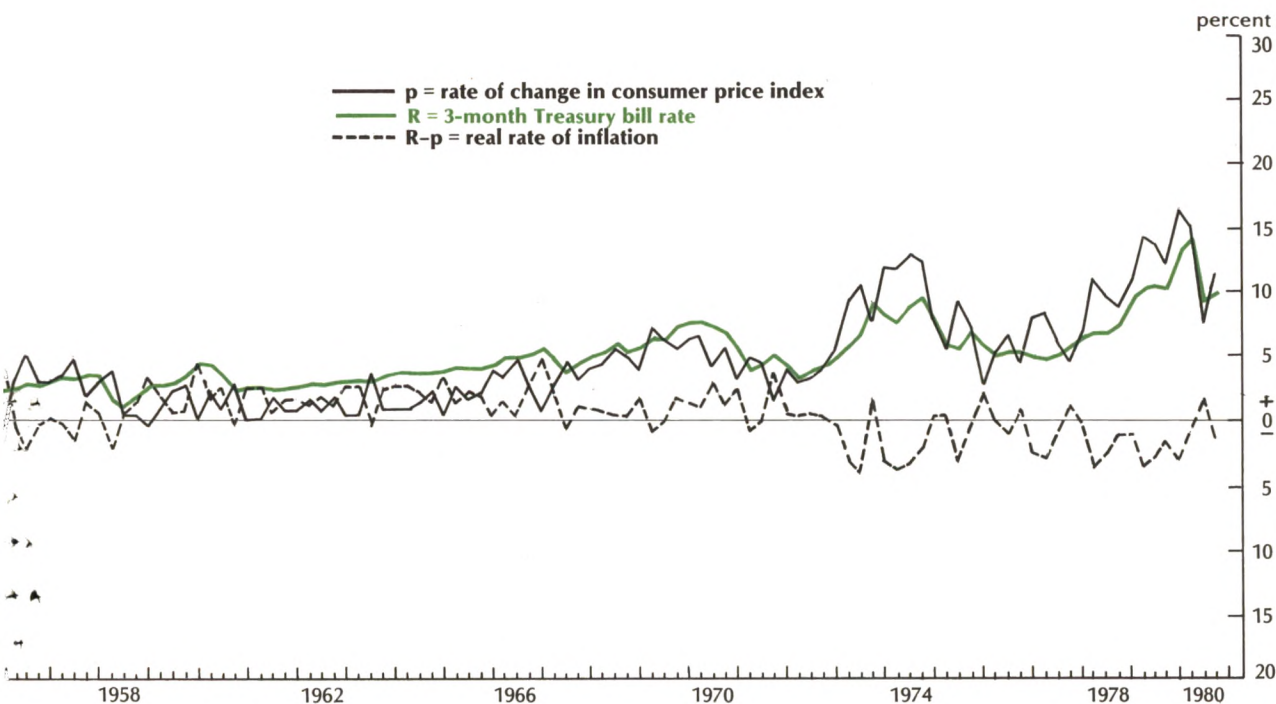
Fisher's correlations, using quarterly observations on the commercial paper rate and the wholesale price index, are shown in chart 3. For interest rates observed between 1890 and 1914, the highest correlation was achieved when rates of inflation lagged 30 quarters were used. The correlations fell as the lag was lengthened. But between 1915 and 1927, the correlation between interest rates and past inflation was continuously improved as the lag was lengthened—up to the maximum lag of 120 quarters tried by Fisher. He performed similar tests with annual data for the United States and Great Britain and the results were the same: assuming that (a) the real rate of interest is constant, (b) expectations of future inflation are determined by past inflation in the manner shown in equation (4), and (c) the approximate equilibrium relation (2) is satisfied, the current interest rate is apparently determined by expectations based on past inflationary experiences as distant as 30 years ago. Fisher wrote: "It seems fantastic, at first

glance, to ascribe to events which occurred last century any influence affecting the rate of interest today. And yet that is what the correlations with distributed effects of p show [5, p. 428]."³

Recent studies of interest rates and inflation

Studies published in 1969 and 1970 by William Gibson [6], Thomas Sargent [10], and William Yohe and Denis Karnosky [12] corroborated Fisher's results. Based on models similar to equation (3) and data taken from periods both before and after World War II, these authors, like Fisher, found that interest rates responded slowly and incompletely to inflation and that long distributed lags of past inflation rates were useful in explaining interest rates. Sargent described his results as

³Fisher's notation has been altered to conform to that used in this paper. For a discussion of Fisher's speculations about the reasons for these results, see Rutledge [9, pp. 19-21].



Box 1

The real rate of interest

Suppose you invest an amount of money, V , at the rate of interest R prevailing on date 0. If P_0 is the average price of goods in your "normal consumption bundle" on that date, you have relinquished purchasing power over V/P_0 goods. A teenager existing exclusively on Big Macs priced at \$1.25 gives up 80 units of current consumption when he deposits \$100 in the local S&L. He does this, presumably, in order to be able to consume an even greater number of Big Macs in the future. At a rate of interest of 5 percent, his investment will grow to \$105 by next year. This will enable him to consume $105/P_1$ units if P_1 is the price of Big Macs next year. The nominal (money) return on his investment is the number of dollars gained as a proportion of the number of dollars invested (relinquished) and in this example is 5 percent. The real (hamburger) return is the number of Big Macs gained as a proportion of the number of Big Macs invested (relinquished). If prices are stable, i.e., $P_1 = P_0 = \$1.25$, \$105 will purchase 84

Big Macs next year and the real rate of return is $4/80 = 5$ percent. But if a 20 percent per annum inflation has occurred so that P_1 is \$1.50, \$105 will be worth only $105/1.50 = 70$ Big Macs and the real return will be $-10/80 = -12.5$ percent. He has gained money but lost goods.

In general, this real rate of interest, r , may be expressed as follows:

$$r = \frac{\frac{V}{P_1}(1+R) - \frac{V}{P_0}}{\frac{V}{P_0}} = \frac{P_0}{P_1}(1+R) - 1$$

Letting $p = (P_1 - P_0)/P_0$ denote the rate of inflation, the above equation may be rewritten as:

$$(1+r) = \frac{(1+R)}{(1+p)} \text{ or } (1+R) = (1+r)(1+p),$$

which is identical to equation (1).

follows: "The results are similar to Fisher's in a couple of ways. Not only do they confirm the importance of the distributed lag price expectations variable, but they imply a very long lag in the process of expectations formation [10]."

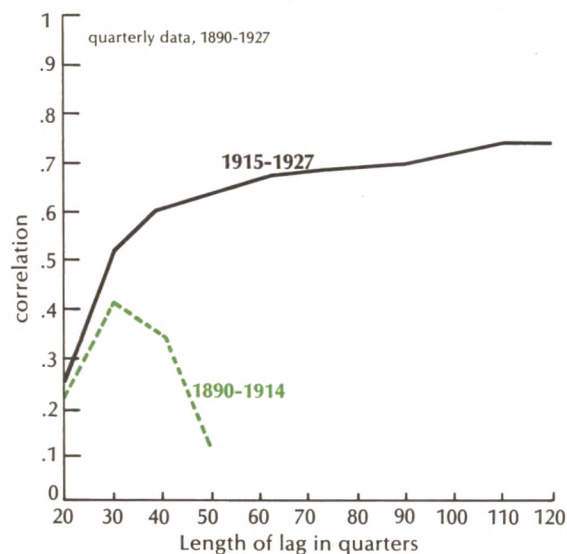
Eugene Fama [4] followed a different method and obtained different results. He used Treasury bill yields and described his estimates as tests of the efficiency of the Treasury bill market.⁴ In efficient markets observed prices and interest rates correctly reflect all of the information available to market participants. This means that (a) observed interest rates correctly reflect the market's inflationary or deflationary expectations and (b) those expectations are unbiased; i.e., expectations, on average, are cor-

⁴More generally, Fama described his estimates as tests of the joint hypotheses of (i) market efficiency and (ii) the constancy of the real rate. This article is concerned only with the first hypothesis. For discussions of the latter hypothesis, see Carlson [1], Fama [4], and Nelson and Schwert [8].

rect. If market expectations were biased and/or were not reflected in interest rates, there would exist opportunities to make substantial sums either by borrowing (if interest rates are "too low") in order to buy goods or by selling goods in order to lend (if interest rates are "too high"). To the statistician, runs of high or low observed real rates are indicated by high autocorrelations, meaning that real rates are highly correlated with their own past values. The concept of efficient markets, which is in turn closely related to rational expectations, is discussed in box 2. Autocorrelation is discussed in box 3.

In general, observed real rates are different from the expected real rates, r , discussed above in connection with equations (1) and (2). This is true for several reasons. Probably the most important cause of differences between expected and realized (observed) real rates is the inability to forecast inflation, p , accurately. For example, the nominal interest rate at time t might be $R = .07$ and be based on

Chart 3. Fisher's correlations between the commercial paper rate and distributed lags of past inflation rates



an expected inflation rate of $p = .03$. This means an expected real rate of approximately $r = .07 - .03 = .04$. But suppose inflation turns out to be 13 percent instead of 3 percent. The realized real rate of return to the nominal investment—the actual gain or loss in purchasing power—is approximately $.07 - .13 = -.06$. Runs of high or low observed real rates would suggest that the market was systematically overpredicting or underpredicting inflation. Under these circumstances nominal rates of interest would not, on average, be accurate predictors of inflation.

Fama's tests of efficiency were limited to observations between January 1953 and July 1971. He began his sample period with 1953 because before 1953 the Federal Reserve interfered with market efficiency by supporting government security prices. He excluded observations after July 1971 because queues, side payments, and increases in the various forms of nonprice rationing caused by price controls prevented stated prices from accurately measuring the costs of acquiring goods.

Fama's tests took two forms. First, he ran autocorrelations on realized real rates of

Box 2

Rational expectations and efficient markets

The concept of *rational expectations* extends the notion of rational behavior to the prediction of economic events. It assumes that people make use of available information in a consistent manner. In particular, predictions of economic events are based upon the public's views of how the economy works. Of course, those views must largely be based upon what has been learned from experience, including observations of past events.

Presented this way, nothing could be less objectionable than rational expectations. There hardly, thus far, seems room for debate. The debate enters with the frequent assumptions by advocates of rational expectations that (i) people have the "correct" view of the economic structure, i.e., that they "know everything," and (ii) new information is instantly and fully reflected in economic decisions. Combined, these assumptions imply no transactions costs and free information about all kinds of processes, simple and complex. The result is *efficient markets*, in which prices and interest rates always fully and correctly reflect all publicly available information.

By "knowing everything," i.e., having the "correct" view of the economic structure, advocates of efficient markets do not mean that people predict the future with certainty. It is assumed, rather, that people know the economy's statistical tendencies. They cannot predict exactly what the rate of inflation, for example, will be. But their predictions will be correct on average. Predictions will not be biased in the sense of being consistently high or low.

interest. Even in efficient markets, predictions will almost always be wrong. But they will not be biased in the sense of being consistently too high or too low. An extreme example of an inefficient market is the period from May 1942 to July 1947, when the Federal Reserve pegged the discount rate on three-month bills at 0.375 percent. During this period the consumer and wholesale price indices rose at average annual rates of 6.2 percent and 7.9 percent, respectively. Monthly changes in the CPI and WPI, at annual rates,

Box 3
Autocorrelation

Suppose x_t is the sales of a company in period t . The autocorrelations of this time series are the correlations of x with its own past values. For example, the first-order autocorrelation, ρ , of x is the correlation between x_t and x_{t-1} . If the company's sales increase by some constant amount c so that $x_t = x_{t-1} + c$, then $\rho = 1$. In this case, x_t and x_{t-1} are perfectly correlated; one consequence of this relation is that x_t may be predicted with certainty if we know x_{t-1} . On the other hand, if x varies in a completely random fashion such that a knowledge of x_{t-1} conveys no information about x_t , then $\rho = 0$. Time series that are subject to smooth cyclical fluctuations have highly positive autocorrelations. Those which rapidly change direction have highly negative autocorrelations. Most American economic time series, including interest rates and inflation, belong to the former category.

exceeded 0.375 percent 40 and 42 times, respectively, during these 62 months. That is, realized real rates of interest were predominantly negative and, in addition, were highly autocorrelated.

Using the CPI and Treasury bill rates, Fama found, as expected, very different results for the 1953-71 period. The first-order autocorrelation coefficients of one-, two-, and three-month real returns on one-, two-, and three-month bills were .09, .15, and .00, respectively. Because these autocorrelations are "close to zero," Fama interpreted his results as consistent with the hypothesis that the Treasury bill market is efficient.

The second series of tests performed by Fama involved estimates of regression equations similar to the following:⁵

$$(5) \quad p_t = -r + R_t + e_t.$$

⁵Fama actually used the rate of change in the purchasing power of money, Δp_t , which is approximately equal to $-p_t$, in his regressions. But his results are fully consistent with regressions of the form shown in equation (5), which has been used for ease of comparison with the work of Fisher and others.

This is similar to Fisher's equation (3) except that (i) the actual rate of inflation, p_t , is used instead of a weighted average of past inflation rates, \bar{p}_{nt} , and (ii) the positions of inflation and R_t in the equation have been reversed. The nominal rate of interest is now the explanatory variable instead of the dependent variable. As in equation (3), e_t is a random error term with mean zero. Equation (5) asserts that, given the assumed constant real rate, r , the market's expectation of the rate of inflation during the period beginning on date t , p_t , is fully reflected in the nominal rate of interest, R_t , observed on that date.

Fama reported regressions for the period 1953-71 on one- to three-month bill yields. In every case the coefficient of R_t did not differ significantly from unity, as suggested by equation (5). His correlation coefficients (between p_t and R_t) were statistically significant and ranged from .54 to .70. Fama also interpreted these results as consistent with the hypothesis that the Treasury bill market is efficient.

Earlier writers had observed that interest rates responded slowly to inflation, i.e., that R_t did not fully reflect expected p_t . This suggests, if similar relations prevailed in the Treasury bill market during 1953-71, that the results obtained by means of equation (5) might be improved by adding past inflation rates as explanatory variables. Fama estimated regressions similar to (6), which he represented as tests of this hypothesis:

$$(6) \quad p_t = -r + R_t + w_1 p_{t-1} + e_t.$$

But the addition of p_{t-1} failed to improve the correlations significantly and the estimates of the coefficient (w_1) of p_{t-1} were statistically insignificant, leading Fama to claim these regressions as further evidence of the efficiency of the Treasury bill market. He dismissed the results of Fisher and others that suggested market inefficiency as probably having been caused by poor price data.

Back to Fisher

Fama's paper elicited critical comments by writers who combined his approach with

Fisher's. Douglas Joines [7] and Charles Nelson and William Schwert [8] pointed out that regression (6) could not fairly be compared with Fisher's results, which depended on many—not one—past rates of inflation. Using Fama's data, they estimated regressions of the form:

$$(7) \quad p_t = r + bR_t + w_1p_{t-1} + w_2p_{t-2} + \dots + w_n p_{t-n} + e_t$$

and found that past rates of inflation contained significant information about future inflation in addition to that reflected in R_t . Furthermore, their estimates of the coefficient (b) of R_t were significantly different from unity. Apparently, during 1953-71 as during 1890-1927, interest rates responded slowly and incompletely to inflation.

Variations in inflation and interest rates during the Fisher and Fama periods of observation are shown in chart 1. The chart shows the rate of change in the wholesale price index and real and nominal returns on four- to six-month prime commercial paper beginning in June 1894, when four- to six-month prime commercial paper rates were first reported on a regular basis. Observations are at five-month intervals expressed in percentages at annual rates. One of the most striking characteristics of this chart is the stability of inflation in Fama's period, 1953-71, compared with the very large fluctuations before 1953 and after 1971. Apparently, Fama's sample is not typical of American experience. This conclusion is supported by chart 2, which shows the rate of change in the consumer price index and real and nominal returns on three-month Treasury bills, beginning with the regular reporting of bill yields in February 1930. Observations are at three-month intervals expressed in percentages at annual rates.

Now let's apply Fama's test of market efficiency to the data shown in the charts. The columns headed ρ in table 1 list the first-order autocorrelations of observed real rates during our complete sample periods and selected subperiods. We have separated the

Table 1
Inflation and real and nominal rates of interest

A

Four- to six-month prime commercial paper
and the wholesale price index

Time period	ρ	Standard deviations		
		p	R	r
6/94 - 4/80	.317	13.79	2.65	16.31
6/94 - 6/29	.264	17.82	1.09	22.98
11/29 - 10/52	.522	13.45	1.10	12.28
3/53 - 2/71	.226	2.10	1.89	2.23
7/71 - 4/80	-.078	7.32	3.41	5.88
7/71 - 1/74	.038	8.83	2.42	7.30
6/74 - 4/80	-.555	6.78	3.69	5.10

B

Three-month Treasury bills and the consumer price index

Time period	ρ	Standard deviations		
		p	R	r
2/30 - 5/80	.569	6.66	2.80	5.66
2/30 - 11/52	.570	8.78	.70	8.07
2/53 - 5/71	.178	2.04	1.68	1.40
8/71 - 5/80	.270	3.80	2.50	1.97
8/71 - 2/74	.259	3.88	1.95	2.47
5/74 - 5/80	.279	3.59	2.54	1.73

ρ is the first-order autocorrelation of r.
Standard deviations are in percentages at annual rates.

post-Fama period into observations falling within the period of price controls, August 1971 to April 1974, and those occurring after price controls were abandoned. The principal results shown in the table may be summarized as follows:

- The first-order autocorrelations are high and significant for both of the full sample periods (1894-1980 in table 1A and 1930-80 in table 1B) and for the subperiods dominated by the Great Depression (with runs of high real rates) and World War II (with runs of negative real rates).

- The 1974-80 subperiod yielded a positive autocorrelation in part B of the table but a negative autocorrelation in part A. This may be due to the frequent accelerations and decelerations of inflation during this period. Perhaps the five-month observational period used in A allows time for reversals in p , and therefore a negative serial correlation of r , not accounted for by the three-month period used in B. We should not put much stock in these results, however, due to the short period of observation.

- Perhaps surprisingly, in view of the different results that have been associated with these subperiods, the first-order autocorrelation of r during 1894-1929, which is largely coincident with the period of Fisher's analysis, is only slightly greater than that for 1953-71, the period of Fama's analysis.⁶ Markets did remarkably well in forecasting the large fluctuations in inflation during the earlier period.

- Notice, however, that the standard

⁶Note that the first-order autocorrelation for 1953-71 (.178) reported in table 1B is higher than the 0.00 reported by Fama. This may be due to the use in the present study of yields that are monthly averages of daily figures. Fama used yields on the first business day of each month. Since price indices are compiled from data that are collected throughout the month, and are therefore monthly averages of a sort, it was felt that comparability between interest rates and inflation required the former also to be expressed in terms of monthly averages.

deviation of R during 1894-1929 was much less than the standard deviation of p . This contrasts with the 1953-71 period, in which the volatility of R was only slightly less than that of p . But this was due less to the greater responsiveness of R during the later period than to the smaller volatility of p .

Conclusions

It should be stressed that much work remains to be done in this area and that none of the results presented in this paper—whether Fisher's, Fama's, or those in table 1—have justified any firm conclusions about the processes that determine observed relations between inflation and real and nominal rates of interest. About all that can be said on the basis of the available data is that, during most periods (excepting especially 1929-52), the Treasury bill and commercial paper markets have not appeared to be highly inefficient. Autocorrelations in real rates are not usually very high. Yet nominal interest rates persistently fail to respond fully to inflation when inflation is volatile. This was true before 1953 and after 1971. Apparently, like other reasonably effective but imperfect processes, the short-term securities markets perform well if not asked to do too much. They can keep up with inflation if the pace is not too fast or too variable.

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Federal tax and spending reform

W. Stephen Smith

The economic legacy of the 1970s has been the continuous upward spiral of inflation, unemployment, and interest rates. The federal government's inability to deal effectively with these problems has placed economic reform at the top of the nation's agenda for the 1980s.

In an effort to deal with these problems, the Congress has considered a wide variety of economic reform proposals in recent years. Several of these proposals have a common theme: the role of the federal government in the economy should be limited and/or reduced. Four of them—three proposed constitutional amendments and one tax reform bill—have received significant attention from prominent politicians and the press:

- The balanced budget amendment, which would require that federal expenditures not exceed federal revenues.
- The spending cap amendment, which would limit federal expenditures to some specified portion of GNP.
- The revenue cap amendment, which would limit federal revenues to some specified portion of GNP.
- The Kemp-Roth bill, which would reduce personal income taxes 30 percent over the next three years.

This article presents an overview of these proposals and discusses their implications for the nation's economic future.

The real sources of economic pain

The first rumblings of the taxpayers' revolt were heard in the late 1960s, as the "go-go" years drew to a close and, partly as a result of the deficit financing of the Vietnam War, inflation began to heat up. The focus of atten-

tion at the time was reform of the local property tax, but few of the organized initiatives met with success. However, the severity of inflation in the late 1970s undoubtedly added strength to the psychology of the taxpayers' revolt movement, which drew widespread attention in 1978 with the passage in California of Proposition 13. As a result of the national attention that was focused on Proposition 13 and its proponents, a number of other states considered and implemented fiscal reforms.¹

In less than a decade, the taxpayers' revolt movement has been transformed from a small, ineffective lobby to a dominant force on the American political scene. What factors were primarily responsible for this change? Economist Lester Thurow has argued that popular support for policies that would bring about a dramatic shift in the distribution of economic resources arises only from intense economic pain.²

An obvious source of such pain was the *apparently* declining standard of living in America. Yet, in the six years (1972-78) of economic turbulence that gave rise to the widespread popularity of tax reform, real per capita disposable personal income rose just under 16 percent, almost as much as during the "go-go" years 1966-72. (See table 1.) To be sure, real hourly earnings in the private nonagricultural sector were slightly lower in 1978 than they had been in 1972, but the decline was more than offset by a sharp rise in the proportion of the total population that is

¹At least 15 states have adopted fiscal limitations since the passage of Proposition 13. The recent recession, however, has apparently reversed this trend, as tax-limitation proposals were defeated in six states in 1980. For an argument that Proposition 13 was not the result of a basic shift in taxpayer attitudes, see James M. Buchanan, "The Potential for Taxpayer Revolt in American Democracy," *Social Science Quarterly*, vol. 59 (March 1979), p. 691.

²Lester Thurow, "The Real Sources of Economic Pain," *Wall Street Journal*, July 6, 1978.

Table 1
Growth in real per capita disposable income

Year	Real per capita disposable income (1972 dollars)	Percent change
1966	3,290	
1968	3,493	6.2
1970	3,668	5.0
1972	3,880	5.8
1974	4,050	4.4
1976	4,216	4.1
1978	4,487	6.4
1980*	4,567	1.8

*Estimated.

SOURCE: *Economic Report of the President*, January 1981.

employed. However, to many households the loss of leisure may have constituted a decline in their standard of living.

In any case, the 16 percent rise in real per capita disposable income might conceal large disparities between groups within the population; it might reflect substantial real gains made by some while many others suffered real economic losses. "Not so," Thurow concludes. "In the six years from 1972 to 1978 there have been no significant shifts in the distribution of income. The gap between rich and poor, black and white, male and female has remained unchanged."³ Since relative incomes have not changed significantly, all groups have benefited from the real economic growth. Of course, it is still possible that there were large differences between individuals within each of these broad groups.

Another frequently mentioned source of economic pain is that the government has taken an ever-increasing share of the average citizen's earnings. Again, the economic evidence does not support the popular assumption. While the ratio of total tax revenue at all levels of government to personal income increased from 17.7 percent in 1950 to 30.1 percent in 1980, most of this increase took

³Ibid.

place during the 1950s and 1960s.⁴ (See table 2.) Government expenditures exhibit almost the same growth pattern. Table 3 shows that while the ratio of total expenditures at all levels of government to GNP has risen from 23 percent in 1950 to 33 percent in 1980, virtually all of the increase took place during the 1950s and 1960s. There has been little growth in the ratio of government expenditures to GNP during the 1970s.

Still another possibility has been suggested by Lester Thurow. He argues that the primary source of pain is the so-called "money illusion" created by the enormous gap between the growth of real and money incomes that has resulted from inflation. While real income grew 16 percent from 1972 to 1978, money income grew 72 percent. People think what life would be like if their incomes had risen by 72 percent with no inflation. Some people may even convince themselves that their real standard of living has fallen.⁵

Most people forget, however, that inflation raises income as well as prices. Every price increase is a reduction in the real living standard of some purchaser of a good or service, but it is also a real income increase for some provider of that good or service. More importantly, most people suffering from the "money illusion" do not realize that if there had been no inflation from 1972 to 1978, real incomes would have grown by 16 percent, not 72 percent.

It is not easy to identify clearcut reasons for the widespread perception of economic stress. It may have resulted in part from a

⁴Richard A. Musgrave has argued that this evidence counters the widely held belief that inflation has resulted in an increasing tax burden. See "The Tax Revolt: Causes and Cure," *Social Science Quarterly*, vol. 59 (March 1979), p. 699.

⁵This is clearly not the type of "money illusion" that is so familiar in the literature of monetary economics. There "money illusion" refers to the temporary failure of people to realize that their real incomes have not kept pace with their nominal wages. In Thurow's use of the term it is precisely the public's awareness, perhaps belated, that their real incomes lag behind their nominal incomes that is the source of pain. The illusion consists in their belief that somehow their real incomes could be made to rise as rapidly as their nominal incomes.

Table 2
Tax revenue as a percentage
of personal income
(all levels of government)

	1950	1960	1970	1980*
Income tax	6.6	10.5	12.4	13.0
Corporation tax	3.1	3.6	3.3	3.1
Payroll tax	1.5	2.8	4.9	7.4
Property tax	2.5	4.2	4.5	3.1
Other	4.0	3.4	3.9	3.5
Total	17.7	24.5	29.0	30.1

*Estimated.

SOURCE: U.S. Bureau of the Census, *Government Finance*, various years. *Economic Report of the President*, January 1981.

“money illusion” that confuses nominal and real measures of economic performance. Nevertheless, *despite* evidence that the government sector did not continue to grow in the 1970s at the rapid rates of the 1950s and 1960s, many people feel that reducing the role of government in the economy provides a prescription for relief from the economic problems facing the nation in the 1980s.

Balanced budget amendment

Of the proposed reforms, the balanced budget amendment is probably the most popular with the general electorate. In a spring 1979 CBS-*New York Times* poll, 73 per-

Table 3
Public expenditures as a percent of GNP

	1950	1960	1970	1980*
Federal	13.4	17.1	18.2	19.5
State and local	7.9	9.8	13.4	13.5
Total	21.3	26.9	31.6	33.0

*Estimated.

NOTE: Federal grants-in-aid to state and local governments are included at the level of the recipient.

SOURCE: *Economic Report of the President*, January 1981.

cent of the respondents favored a constitutional amendment to require the Congress to balance the budget every year. Legislators in 30 of the necessary 34 states have approved resolutions asking the Congress to call a constitutional convention to consider such an amendment. Three other states have adopted resolutions that urge the Congress to adopt a balanced budget amendment, but do not call for a convention. The convention movement, however, has met with significant opposition from several key political figures who fear a “runaway” convention that would attempt to adopt amendments on other issues such as busing and abortion.

The balanced budget amendment is something of a misnomer, because the proposal would bar the federal government from incurring deficits, but not from attaining surpluses. Of course, surpluses have been few and far between in recent years. A more substantive shortcoming of the amendment is that, even if it achieved the goal of eliminating deficits, it would not necessarily limit or reduce the role of the federal government. The government could continue to increase spending, in absolute terms and in relation to GNP, as long as it increased tax revenues to keep the budget balanced.

Aside from its inappropriateness as a means to achieve the goals of some of its proponents, the balanced budget amendment might severely impair the government’s ability to influence the economy. Prior to the Depression the government pursued the “fiscally responsible” policy of balancing the federal budget. This “old-fashioned doctrine,” according to economist Robert J. Gordon, “did considerable harm to the economy and has since been abandoned by all economists, monetarists and nonmonetarists alike.”⁶ Why? During a recession GNP declines along with personal and corporate taxable incomes. If tax rates and government expenditures remain constant, and the budget was in balance just before the recession, the budget will now

⁶Robert J. Gordon, *Macroeconomics* (Little, Brown and Company, 1978), p. 480.

show a deficit. To rebalance the budget, the federal government must either raise tax rates or reduce government expenditures, either of which will exacerbate both the recession and the deficit.

Attempting to balance the actual budget during a recession ignores the fact that while the budget affects the economy, the economy has a feedback effect on the budget. Although, in principle, the government could stimulate the economy by raising both expenditures and tax rates during a period of slack private demand, thereby maintaining the budget in balance, the administrative and political difficulties of doing so probably preclude such an approach.

The balanced budget amendment, in and of itself, is unlikely to enhance the government's ability to control inflation. Although government deficits have some short-run impact on demand, they are not inflationary in the long run unless they are financed by increases in monetary growth in an attempt to hold down interest rates. Other things being equal, a government deficit financed by the sale of Treasury securities, accompanied by rising interest rates and no increases in money supply, would not add to inflationary pressures. In this context the balanced budget amendment appears to be neutral in its expected impact on inflation.

Even with such an amendment in place, the Congress and the President would have many ways of maintaining expenditures. Off-budget outlays could be increased. The federal government in fiscal 1980 allocated \$12 billion to off-budget entities and \$19.1 billion to government-sponsored agencies, roughly 6 percent of the total budget. Loan guarantees, another method of avoiding the budgetary process, amounted to \$284 billion in 1980.

In sum, the available evidence suggests that a balanced budget amendment may create as many problems as it solves. While it might, in a nominal sense, eliminate future federal deficits, it is not unequivocally clear that this is a desirable goal. Even if it were, there is no assurance the government would not circumvent the intent of the proposal.

Moreover, the amendment would take away an important recession-fighting tool of the federal government and, in fact, might deepen any future recessions.

Spending cap amendment

This proposed constitutional amendment would limit spending by the federal government to a certain percentage of GNP. The specific percentage varies with alternative proposals, but virtually all have fallen into the 18 percent to 21 percent range. The spending cap amendment has been advocated most strongly by economist Milton Friedman and the National Tax Limitation Committee. Their amendment includes provisions that would limit off-budget outlays, allow the spending limit to be exceeded in national emergencies, and protect grants to state and local governments. It would limit the growth of the federal government's share of economic activity, but is silent on the question of deficits.

By limiting government spending, the amendment would tend to weaken the government's recession-fighting capabilities. This effect would not be as serious as under the balanced budget amendment, however, since the government would retain the authority to cut taxes during recessionary periods. In the long run the amendment might be helpful in fighting inflation caused by monetization of deficits because it would hold the growth of government expenditures below that of nominal GNP. Over the past decade federal expenditures grew at an annual rate of 10.5 percent, well above the 9.5 percent growth rate of GNP.

The amendment has other disadvantages. First, since certain expenditures rise automatically (for example, unemployment insurance benefits during a recession), other expenditures would presumably have to be reduced. This would create a great deal of uncertainty with regard to the planning of certain expenditure programs. Second, it would limit the ability of the government to target expenditures during a recession toward certain hard-hit or disadvantaged areas, industries, or indi-

viduals since any increased expenditures in these areas would have to be offset by decreases elsewhere.

Revenue cap amendment

A third proposal, less frequently discussed, is the revenue cap amendment, which would limit federal revenues to a certain percentage of GNP. This amendment would not eliminate deficits as it controls only government revenues, not government spending. Although it would weaken the government's ability to fight recession to a lesser extent than the balanced budget amendment, the revenue cap amendment would somewhat inhibit the government's range of inflation-fighting strategies. One consequence of our tax structure is that federal revenues tend to grow faster than the general economy during inflationary periods. The amendment would force the government to cut tax rates to hold down tax revenues during inflationary times. As a result, fiscal policy would be of little use in attenuating inflationary trends.

Implementation of the proposal would be relatively easy, unless the cap were set at a much lower level than present tax collections. As noted earlier, federal taxes did not rise dramatically during the 1970s; had the amendment been adopted in 1970, with the cap set at the then-prevailing level, it would not have been exceeded to date. While the economy and federal spending grew at annual rates of roughly 9.5 percent and 10.5 percent, respectively, over the past decade, federal revenues grew at roughly 8.5 percent. Thus, unless the cap were lowered to a pre-1970 share of the GNP, the revenue cap amendment is not likely to reduce significantly the government's share of economic activity. On the other hand, it should prevent that share from growing significantly in the future.

Kemp-Roth bill

A fourth reform proposal, and the one which has received the most political atten-

tion, is the Kemp-Roth bill, which calls for a 30 percent reduction in federal income taxes over the next three years. Proponents of the bill have argued that reducing personal income taxes will increase incentives to work and will expand the tax base so that, even at the lower rates, no tax revenues are lost. The theory behind this argument is summarized by the Laffer Curve, named for its originator, economist Arthur Laffer (see box).

Prior tax cuts. Many proponents of the bill have argued that prior tax cuts, particularly the Kennedy tax cut, provide empirical confirmation of the Laffer Curve hypothesis. Walter Heller, the key architect of the Kennedy tax cut, has responded that the supply-siders' arguments are flawed. Taxes were cut by about \$12 billion (\$10 billion individual and \$2 billion corporate) in 1962-64; Heller notes that "the record is crystal clear that it was its stimulus to *demand* . . . that powered the 1964-65 expansion and restored a good part of the initial revenue loss."⁷ Unemployment was reduced from 5.6 percent in January 1964 to 4.5 percent in July 1965, and utilization rates in manufacturing increased, drawing on existing excess capacity. Since inflation rose only slightly over the same period, from 1.4 percent to 1.6 percent, most of the increase in demand was converted into more output, not higher prices.

However, the premise that any change in economic activity after a tax cut is a result of the tax cut ignores the multiple causal relations in a complex economy. Other fiscal factors playing a critical role in the 1963-68 expansion, for example, were the huge (over) stimulus of Vietnam expenditures, the four increases in payroll tax rates and base in those years, and the \$6 billion of revenues from the 1966 Tax Act. Moreover, monetary policy also played some role in the expansion. After slowing in 1962, money supply growth accelerated in 1963 and 1964. Similar difficulties in isolating the effects of tax cuts from other influences plague the other historical exam-

⁷Walter W. Heller, "The Kemp-Roth-Laffer Free Lunch," *Wall Street Journal*, July 12, 1978.

ples, the Mellon tax cuts in the 1920s and the West German cuts in 1948, which the Kemp-Roth proponents use to support their theory.

Economic evidence. The economics profession has been studying questions related to the Laffer hypothesis for several years. There is little economic evidence, however, to support the conclusion that current levels of tax rates create disincentives to work and save. Studies of worker response to changes in take-home pay have yielded ambiguous results. Some people will work harder if a tax cut or some other change makes each hour of work worth more; others choose to take additional time off and enjoy more leisure while earning the same income.

After reviewing the available evidence, the Congressional Budget Office concluded that hours worked would increase if after-tax real wages rose, largely because of the impact of married women entering the labor market. The net effect, however, would be small—perhaps a 1 percent to 3 percent increase in the labor supply as a result of a 10 percent rise in disposable income.⁸ This estimate falls short of the minimum 10 percent increase in the labor supply which would be necessary for the Kemp-Roth cuts to be self-financing.⁹

The effect of changes in the after-tax rate of return on savings is also an empirical question, and available evidence is also ambiguous.¹⁰ Some people will save more if they earn a higher rate of return; others will save less and maintain a constant level of assets. Many economists have long accepted what has become known as Denison's Law, that the saving rate is virtually constant and unaffected by changes in the tax structure or the

⁸Congressional Budget Office, *An Analysis of the Roth-Kemp Tax Cut Proposal* (Government Printing Office, 1978), pp. 14-16.

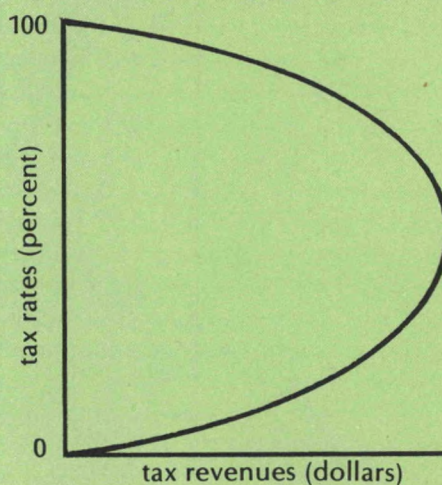
⁹This conclusion is based on the liberal assumptions that actual output is currently 4 to 5 percent below potential production and that capital-output and labor-output ratios are constant. *Ibid.*, pp. 8-9.

¹⁰Richard A. Musgrave and Peggy B. Musgrave, *Public Finance in Theory and Practice* (McGraw-Hill Book Company, 1973), p. 478.

The Laffer Curve

Laffer argues that taxes create a "wedge" between salary and take-home pay and between pre-tax and after-tax investment profits. As the tax rate rises, people begin shifting out of productive activities (which are taxed) into less productive, frequently leisure, activities (which are not taxed) and tax revenue drops. If the government were to tax 100 percent of all earnings, Laffer argues, no one would work and there would be no revenue from taxes.

Due, in part, to its intuitive appeal, the Laffer Curve has enjoyed a modicum of success in political circles. Most economists, however, have argued that the theory does not necessarily support the conclusion that tax cuts will be self-financing. The true shape of the Laffer Curve is an empirical question. There is little evidence available to show that the curve ever bends backwards, much less that it is symmetrical. Moreover, there is virtually no evidence which demonstrates that our present tax structure is anywhere near the backward bending portion of the curve.



real after-tax rate of return on capital.¹¹ Proponents of Kemp-Roth respond with the recent findings of Stanford's Michael Boskin that the total elasticity of private saving with

¹¹Edward F. Denison, "A Note on Private Saving," *Review of Economics and Statistics*, vol. 40 (August 1958), pp. 261-7.

respect to income is 0.3 to 0.4.¹² The methodology of the study, however, has been strongly criticized.¹³ Moreover, even if Boskin's findings are accepted, the resulting increase in saving falls far short of the minimum 10 percent increase necessary for the Kemp-Roth cuts to be self-financing.¹⁴

Econometric studies. Laffer and his supporters criticized the major macroeconomic forecasting models for excluding the economic responses which they describe. Arguing that no present model could accurately capture the economic impact of the Kemp-Roth proposal, Laffer constructed his own model that demonstrates the revenue feedback effects of his curve. The report describing the model has been quoted as acknowledging that "the task of quantifying the theoretical Laffer Curve is unachievable." Moreover, the only group that responds in accord with Laffer's theory is the working poor. For all other groups, the model suggests that the government should increase tax rates to increase revenue.¹⁵

Other models, specifically reformulated to include the Laffer hypothesis, have concluded that the revenue feedback effects anticipated by Laffer would not occur. Congressional committees commissioned two consulting firms, Data Resources, Inc. and Evans Economics, to build models to test the Laffer theory. The models, although quite different in construction, reached similar conclusions: implementation of a 30 percent across-the-board cut in tax rates, without sig-

nificant expenditure reductions, would add between \$85 billion and \$135 billion to the annual budget deficit by 1985 and would add at least 2 percentage points to the inflation rate.¹⁶

While Kemp-Roth may have more political support than any of the proposed constitutional amendments, it also has the most potential for economic harm. While it will unquestionably reduce tax rates, there is little evidence to support the conclusion that it will pay for itself in the short run. In fact, most of the econometric models, including those that make Laffer Curve assumptions, forecast that the bill will simply produce larger deficits and increased inflation unless accompanied by significant spending cuts.

Summary

The Congress has considered a variety of proposals for economic reform over the past few years, several of which seek to limit and/or reduce the role of the federal government in the economy. Of the four plans analyzed here, the spending cap amendment appears to be the one best-suited to achieve these ends. However, economic evidence suggests that reducing and/or limiting the federal government's role may not eliminate the true sources of economic pain. Similarly, available evidence casts some doubt on the reasonableness of the income and revenue effects predicted by proponents of the Kemp-Roth bill. But a real test must await the tax cut's actual adoption and implementation. Any determination as to which of the four proposals is "best" is ultimately a value judgement and will vary with the social, political, and economic predilections of each individual. The purpose of this article has been simply to synthesize some of the economic information necessary to determine the tradeoffs.

¹²Michael J. Boskin, "Taxation, Savings, and the Rate of Interest," *Journal of Political Economy*, vol. 86 (March/April, 1978), pp. S3-S27.

¹³Boskin defines personal saving to include consumer durables; thus, increased saving does not necessarily mean that more funds are available for investment. His omission of the inflation rate from the estimating equation and the particular time period studied may have strongly influenced his results. Finally, the presence of substantial serial correlation may affect the statistical significance of his findings. See Congressional Budget Office, p. 18.

¹⁴Congressional Budget Office, p. 9.

¹⁵"The Impact of a Reagan-Style Tax Cut," *Business Week* (June 9, 1980), pp. 90, 95.

¹⁶*Ibid.* See also Stephen Brooks and Otto Eckstein, "Economic Analysis of the Kemp-Roth Proposal," *Data Resources U.S. Review* (August 1978), pp. 1.12-1.15.

The discount rate—will it float?

Paul L. Kasriel

Since the Federal Reserve adopted its new reserves-oriented operating procedure on October 6, 1979, the role of discount policy has come under greater scrutiny both inside and outside the System. Of special interest has been the spread between the federal funds rate and the discount rate. There is a strong positive association between the federal funds rate-discount rate spread and the amount of reserve adjustment borrowing from the Federal Reserve.¹

Some analysts have criticized the Fed for allowing this spread to widen as much as it has on certain occasions. They argue that the wide spread induces depository institutions (hereafter referred to as banks) to borrow reserves from the Fed at what might be considered a subsidy rate. In their view banks' increased incentive to borrow from the discount window when the discount rate is low relative to money-market rates diminishes the Fed's control over total reserves and, thus, the money supply. In order to keep the spread between money-market rates and the discount rate smaller and more stable, it has been suggested that the discount rate be allowed to float with a money-market rate such as the federal funds rate. This article explains the discount mechanism and discusses the implications of a floating discount rate within the current framework of reserve accounting and open market operating procedure—namely, lagged reserve accounting and nonborrowed reserve targeting.

The discount mechanism

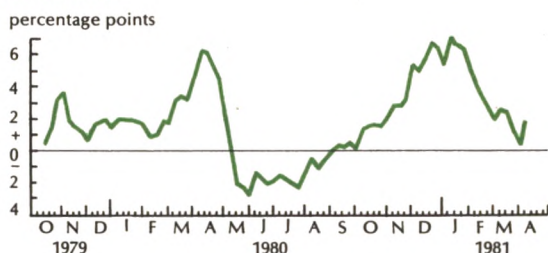
Under the system of lagged reserve accounting adopted in 1968, the average level of reserves that a bank is required to hold as a deposit at the Fed and/or in vault cash in a

¹Reserve adjustment borrowing excludes seasonal and special borrowing.

As reserve adjustment borrowing from the Fed rises . . .



. . . the spread between the federal funds rate and the discount rate increases



given reserve settlement week is determined by the reserve requirement ratios (set by the Fed) applied to the average level of the bank's reservable liabilities two weeks prior. Thus, changes in a bank's deposits and other reservable liabilities during the current reserve settlement week cannot change its required reserves for this week. Upon entering the settlement week, each bank knows the average level of reserves it must hold in order to satisfy its reserve requirements and the Fed knows what average level of reserves it must supply so that the banking system can satisfy its reserve requirements.

Reserves can be supplied in two ways—through Fed open market operations (nonborrowed reserves)² and through discount window lending (borrowed reserves). Any shortfall in nonborrowed reserves compared

²So-called market factors such as float also provide nonborrowed reserves. The Fed attempts to offset undesired changes in nonborrowed reserves caused by market factors through open market operations.

to required reserves must be made up by borrowed reserves.³ Under the Fed's new operating procedure, open market operations are conducted so as to hit a targeted level of nonborrowed reserves on a weekly average basis. Since required reserves are predetermined in any given week because of lagged reserve accounting, the choice of a weekly level of nonborrowed reserves largely determines the weekly level of borrowed reserves.⁴

Although the weekly amount of borrowed reserves for the banking system is determined once the Fed chooses a nonborrowed reserve target, borrowings by individual banks from the discount window are not. An individual bank can obtain reserves in several alternative ways, including purchasing federal funds, selling CDs, or selling a security from its portfolio. These alternatives redistribute the existing quantity of reserves among banks. They do not increase the reserves of the banking system as a whole. In contrast, borrowing from the Fed increases both the borrowing bank's reserves and those of the banking system.

If a bank could borrow from the Fed as much and as often as it desired at the discount rate, then the discount rate would serve as a cap to the federal funds rate. The fact that the federal funds rate is usually above the discount rate when nonborrowed reserves are less than required reserves is *prima facie* evidence that the discount rate does not measure the full cost of borrowing from the Fed. The full cost of borrowing from the Fed, or

the effective discount rate, is the sum of the quoted discount rate plus the nonpecuniary costs resulting from discount window administration. Because the Fed tries to limit the amount and duration of borrowing by individual banks, by subjecting their lending and investment practices to "surveillance," and because banks wish to assure themselves access to the window in the future when they may face liquidity problems, the nonpecuniary costs of borrowing an additional dollar rise with the quantity and frequency of borrowing by an individual bank. These costs would rise even with an unchanged level of borrowing if the administration of the discount window were to get "tougher."

To minimize its costs, an individual bank will manage its reserve position in such a way that the effective discount rate on an additional dollar borrowed from the Fed will be equal to the cost of acquiring reserves from alternative sources. At the margin, then, there is no subsidy involved in borrowing from the Fed when the effective rather than the quoted discount rate is compared with the cost of alternative sources of funds.⁵ Because borrowing federal funds is a substitute for borrowing at the discount window, this cost can be measured by the federal funds rate. Thus, the effective discount rate tends toward equality with the federal funds rate, and the spread between the federal funds rate and the quoted discount rate measures the marginal nonpecuniary cost of borrowing from the Fed.

If the Fed provides less nonborrowed reserves than required, then those banks for which the effective discount rate is higher than the costs of alternative sources of funds will attempt to obtain reserves from these sources, thereby driving up their interest rates. Some reserve-deficient banks will be induced to increase their borrowings from

³This abstracts from reserve carryover, the privilege banks have of carrying over a surplus or deficiency of up to 2 percent of required reserves into the following reserve settlement week.

⁴If banks' demand for excess reserves (i.e., reserves in excess of those required) were zero or constant, then the choice of a weekly level of nonborrowed reserves completely determines the weekly level of borrowed reserves. To the degree that banks' demand for excess reserves varies, then a given weekly level of nonborrowed reserves does not completely determine a weekly level of borrowed reserves. Because excess reserves tend to be relatively small and stable, the analysis is not materially affected by them and, therefore, it will be assumed that they are zero.

⁵However, there is a subsidy on average because the full nonpecuniary costs of borrowing are incurred only on the last dollar borrowed; on the intramarginal borrowing the bank incurs below-market costs. For monetary policy purposes, of course, it is only the marginal cost that is relevant.

the Fed as the alternative cost of funds rises to the level of their effective discount rates. Interest rates will continue to rise until banks are induced to borrow enough from the Fed to meet their required reserves. This rising cost of reserves will eventually cause banks to curtail the expansion of their assets and, hence, slow the growth of the money supply.

It can be seen, then, that a penalty discount rate policy—i.e., a policy whereby the Fed always maintains the quoted discount rate above the current federal funds rate—is theoretically inconsistent with lagged reserve accounting and nonborrowed reserve targeting. The way in which the market for bank reserves comes into equilibrium when the level of nonborrowed reserves is set below that of required reserves is for the federal funds rate to rise to a level above the quoted discount rate such that individual banks are induced to borrow enough reserves from the Fed to eliminate the reserve deficiency for the banking system. A penalty discount rate would prevent the reserves market from reaching equilibrium because no bank would be willing to borrow from the Fed as long as it could obtain reserves in the federal funds market at a rate below the discount rate. The federal funds rate would continue to ratchet upward until the Fed provided additional nonborrowed reserves (i.e., above the targeted level) to eliminate the reserve deficiency.⁶

With contemporaneous reserve accounting where the current week's required reserves are determined by the current week's reservable liabilities, a penalty discount rate would, in theory, be feasible and would be equivalent to the Fed closing down the discount window for reserve adjustment borrowing. As the federal funds rate rose and banks sold securities to the nonbank public in order to acquire reserves, reservable liabilities of the banking system would decline and, thus, reduce the current week's required reserves. The federal funds rate would continue to rise

⁶Alternatively, at some level of rates, banks might bid so aggressively for deposits as to attract currency out of circulation, which the banks could then ship to the Fed to meet their reserve requirements in the current week.

until reservable liabilities declined to the point where required reserves were reduced to a level equal to nonborrowed reserves.⁷ In practice, sharp increases in the federal funds rate might occur so as to induce banks to make the portfolio adjustments necessary to reduce required reserves to the targeted level of nonborrowed (and in this case, total) reserves in as short a time as a week.

Floating the discount rate

As mentioned at the outset, some analysts have suggested that the quoted discount rate be allowed to float with a particular money-market rate (e.g., the federal funds rate) or some composite index of money-market rates in order to keep the spread between market rates and the discount rate more stable. For example, the quoted discount rate in the current week might be set at 50 basis points (0.5 percentage points) above the previous week's average federal funds rate. But it has been seen that the spread between the federal funds rate and the quoted discount rate in the current week depends critically on the amount of borrowing forced on the banking system by the Fed's choice of a nonborrowed reserves target and the attendant nonpecuniary costs of such borrowing. Floating the discount rate would have no impact on the stability of the federal funds rate-discount rate spread.

Floating the discount rate would, however, have important implications for the behavior of the federal funds rate and other related interest rates in a framework of lagged reserve accounting and nonborrowed reserve targeting. Consider the following two relationships:

$$(1) (RFF_t - RD_t) = cBR_t + e, \quad c > 0, BR_t > 0$$

$$(2) RD_t = RFF_{t-1} + K,$$

⁷Under lagged reserve accounting, the rising federal funds rate would also cause the current week's reservable liabilities to fall, but this would have no effect on the current week's required reserves.

where RFF is the federal funds rate, RD is the discount rate, c is the coefficient reflecting the marginal nonpecuniary costs of borrowing from the Fed, BR is borrowed reserves (dollars), e is an error term, K is a constant (percentage points) and t refers to the time period (e.g., week). The first relationship says that the spread (in percentage points) between the current federal funds rate and current discount rate is an increasing function of the amount of reserves borrowed by the banking system from the Fed. The second relationship is a formula for floating the discount rate. The constant K can be assigned positive, negative, or zero values. Substituting (2) into (1) and ignoring e yields the following relationship:

$$(3) \text{RFF}_t - \text{RFF}_{t-1} - K = c\text{BR}_t.$$

This can be rearranged as:

$$(3a) \text{RFF}_t - \text{RFF}_{t-1} = c\text{BR}_t + K.$$

If K is positive, i.e., the current period's discount rate is set above the previous period's federal funds rate, then relationship (3a) implies that the current period's federal funds rate will always be higher than the previous period's so long as the banking system is forced to borrow from the Fed. This implication also applies if K is zero. Thus, even if borrowing from the Fed were declining, the federal funds rate would ratchet upward until banks' deposits and other reservable liabilities slowed enough to cause required reserves to fall below the Fed's nonborrowed reserve path, at which point the federal funds rate would fall rapidly toward zero.⁸ The discount rate, being tied to the federal funds rate, would also plummet. As soon as banks were once more forced to borrow from the Fed,

⁸Relationship (1) above applies only when borrowed reserves are greater than zero. For a detailed discussion of why the federal funds rate falls rapidly toward zero as nonborrowed reserves are increased above required reserves, i.e., borrowed reserves are zero, see Robert D. Laurent, "A Critique of the Federal Reserve's New Operating Procedure," *Staff Memoranda* No. 81-4 (Federal Reserve Bank of Chicago, forthcoming).

the federal funds rate and the discount rate would start to ratchet up again.⁹

A somewhat different result is possible if K is negative, i.e., the current period's discount rate is less than the previous period's federal funds rate. If borrowed reserves are less than (or equal to) some critical value, then the federal funds rate need not rise continuously but could decline (or remain constant) from period to period. This critical value can be obtained from relationship (3a). These conditions may be stated as:

$$(4) \text{RFF}_t - \text{RFF}_{t-1} \geq 0 \text{ as } \text{BR}_t \geq \frac{-K}{c}.$$

The critical value, then, is $-K/c$ (remember, in this case, $K < 0$ so $-K > 0$). If borrowed reserves had been above the critical value and, for some reason, fell below, then the federal funds rate could decline.


Conclusion

Floating the discount rate, then, would not necessarily keep the federal funds rate-discount rate spread more stable, but because of its possible upward ratcheting effect on the federal funds rate, it could tend to produce quicker bank portfolio and deposit responses than would be the case under a more constant discount rate policy.

There remains the question whether the benefits of the more rapid deposit responses resulting from a floating discount rate policy would be greater than the costs of the consequent increased interest rate volatility.¹⁰

⁹This analysis assumes that the Fed adheres to its nonborrowed reserves path without any interest rate constraints being self-imposed. Notice that even with a constant as opposed to floating discount rate, a nonborrowed reserves targeting policy implies a very sharp drop in the federal funds rate once nonborrowed reserves are greater than required reserves. However, the constant discount rate policy does not imply a continuously rising federal funds rate when nonborrowed reserves are less than required reserves.

¹⁰For a discussion of the social costs of interest rate volatility, see Paul L. Kasriel, "Interest Rate Volatility in 1980," *Economic Perspectives*, Federal Reserve Bank of Chicago, (January/February 1981), pp. 16-17.



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