FEDERAL DEFICITS, INFLATION, AND MONETARY GROWTH: CAN THEY PREDICT INTEREST RATES?

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This article traces the short-run impact of fiscal policy, inflation, monetary growth, and economic activity on interest rates. Its theoretical framework is a loanable funds theory of interest rate determination, which incorporates both neoclassical and Keynesian elements. This framework is useful for analyzing the crowding out effect, real versus nominal interest rates, the relative importance of M1, M2, and M3, and the inflation-savings relationship in a financial markets setting. The implications of this theory are tested against interest rate movements during recent years. The resulting equations may be useful to investors in predicting the impact of fundamental economic changes on interest rates, an impact that may not be evident in term structure yield curves.[1]

Loanable Funds Theory Current loanable funds theory builds on the foundation of an eighteenth century doctrine that was concerned with savings and investment in a barter economy with no governmental sector.[2] The modern inclusion of government finance, money, and inflation in the analysis allows "the interest rate"—a composite of the spectrum of interest rates in related financial markets—to be determined directly by demand and supply curves.[3]

The Demand for Loanable Funds In the traditional theory, the demand for loanable funds was for the purpose of financing investment in real sector assets, such as commercial and residential construction, inventories, and plant and equipment. The demand for such investment depends upon the cost of capital, for which interest rates serve as a proxy. The productivity of investment —its rate of return—is determined by income, technology, and the existing stock of capital. The lower the cost of capital, the higher the net return from investment: its productivity less its interest cost. The same sort of relationship applies to household investment in residential housing, which is largely financed by mortgage borrowing. The investment schedule, the I line in Figure 1, shows that more investment is planned at lower interest rates.

Investment demand also responds to changes in output. If output rises, firms find it profitable to invest in plant, equipment, and inventories. As output rises, the demand for residential housing eventually increases. The investment schedule in Figure 1 would thus shift to the right when

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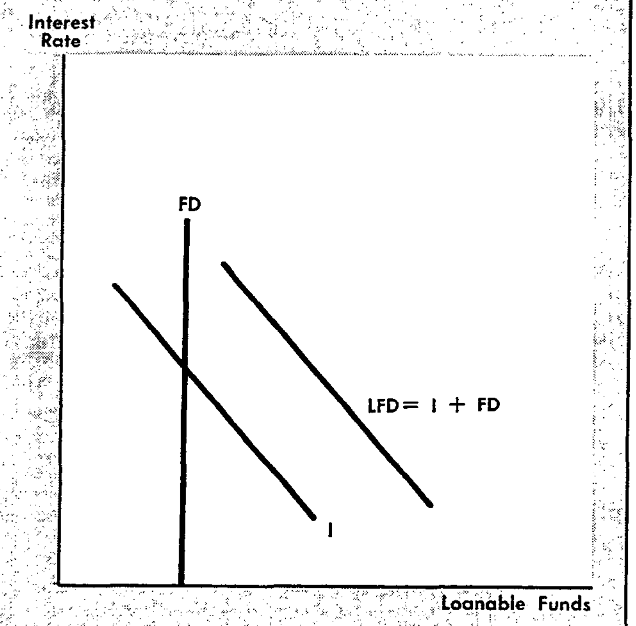
[1] Yield curves that relate short rates to long rates can shift dramatically over time. For comparisons of the predictive ability of economic and term structure interest rate models, see Michael E. Echols and Jan W. Elliott, "Rational Expectations in a Disequilibrium Model of the Term Structure," *American Economic Review* (March 1976), pp. 28-44; Martin Feldstein and Gary Chamberlain, "Multimarket Expectations and the Rate of Interest," *Journal of Money, Credit and Banking* (November 1973), pp. 873-902; and Lacy H. Hunt, "Alternative Econometric Models for the Yield on Long-term Corporate Bonds," *Business Economics* (September 1973), pp. 31-8.

[2] Mark Blaug, *Economic Theory in Retrospect* (Homewood: Irwin, 1968); Don Patinkin, *Money, Interest, and Prices* (New York: Harper, 1965).

[3] Several versions of loanable funds theories are described in Joseph W. Conard, *An Introduction to the Theory of Interest* (Berkeley: University of California Press, 1959); Frederich A. Lutz, *The Theory of Interest* (Chicago: Aldine, 1969); and S. C. Tsiang, "Liquidity Preference and Loanable Funds Theories, Multiplier and Velocity Analyses: A Synthesis," *American Economic Review* (September 1956), pp. 539-64. Less technical treatments appear in: John A. Cochran, *Money, Banking and the Economy* (New York: Macmillan, 1967); Charles N. Henning *et. al. Financial Markets and the Economy* (Englewood Cliffs: Prentice-Hall, 1975); Murray E. Polakoff *et. al. Financial Institutions and Markets* (Boston: Mifflin, 1970); and John G. Ranlett, *Money and Banking* (New York: Wiley, 1969).

Figure 1

THE DEMAND FOR LOANABLE FUNDS



real output rises, through the so-called accelerator relationship.

The modern loanable funds theory recognizes that government deficit financing also creates a demand for loanable funds. Massive government spending in recent years could not have been funded entirely by taxes without creating social unrest and reducing real output. Governments borrowed in private credit markets to fill the resulting gap. Federal Government demand for funds is insensitive to changes in interest rates. This interest-inelastic demand for funds is shown as the line FD in Figure 1. In a large-scale model of the economy, the FD demand for funds could be endogenous, i.e., determined by income through income taxes and by politically determined Government spending. In practice, Federal planners specify a given deficit as a measure of fiscal stimulus, making the deficit a largely predetermined (exogenous) policy tool.

In contrast, funds raised by state and local governments largely represent capital expenditures on education, highways, housing, and public utility projects. These long-term projects resemble business capital expenditures in their sensitivity to interest rates. For example, state and local interest rate laws may prohibit new debt issues by these governments at rates exceeding specified ceilings. Their demand for funds is essentially investment demand, despite borrowing on current account by certain governments.[4]

The demand for loanable funds (LFD) thus consists of the sum of FD and I, as shown in Figure 1. (Consumer credit other than mortgages is treated as a deduction from savings.)

The Supply of Loanable Funds The supply of loanable funds is a rather complex sum of savings by individuals and businesses, changes in the flow of credit extended by financial institutions, and variations in the public's desire to hold money.

Savings by individuals respond positively to the reward for thrift at a given level of income. The higher the interest rate, the greater the amount of future consumption that can be obtained by refraining from present consumption. Hence, the savings schedule S slopes upward in Figure 2. The supply of savings schedule also responds to changes in income, shifting to the right as higher income allows consumers and businesses to save more. This income effect may be more important that the interest effect on savings.

The traditional theory of the supply of loanable funds incorporates changes in the flow of bank credit, which result from changes in the supply of money. Newly created reserves (high-powered money) flow through the banking system when the central bank engages in open market purchases of Government securities. This causes banks to possess more nonearning reserves than they wish to retain and to use this liquidity to purchase financial claims until their cash is again in balance with their other desired portfolio holdings. The resulting increase in the supply of loanable funds is represented by the horizontal distance Δm in Figure 2.

Commercial banks tend to increase their credit output derived from the new reserves more when interest rates are high than they do when rates are low. Banks decrease their excess reserves when the reward for lending increases.[5] This

[4] State and local governments as a group generated a surplus of \$51.7 billion from 1969 through 1975, mainly through their pension funds. Over half the new municipal security issues from 1964 through 1974 funded the four types of capital expenditures cited. (All statistics in this article are taken from Federal Reserve sources such as *Flow of Funds* accounts and *Federal Reserve Bulletins*.)

[5] When earning asset returns are high enough, banks not only practice this form of asset management but also increase the size of their portfolios by borrowing nondeposit funds: certificates of deposit, discounts and advances from the Federal Reserve, etc. Funds borrowed at the discount window increase the money supply, as well as bank credit.

behavior increases interest elasticity of the (S + Δm) curve relative to the S curve.

The increased supply of loanable funds Δm may be derived in practice from changes in M1, M2, or M3. M1, the sum of currency and demand deposits, is directly responsive to changes in monetary policy. M2, defined as M1 plus noncertificate time and savings deposits at banks, and M3, defined as M2 plus similar deposits at nonbank financial institutions, are more inclusive measures of liquidity in the economy.[6]

These monetary aggregates are important determinants of the supply of credit funds to mortgage and other longer-term borrowers by financial institutions. Increased savings and/or shifts from the public's desired M1 balances into insured earning assets result in increases in consumer time and savings deposits (part of M2 or M3), which are quickly supplied to credit markets by financial institutions after provision for (rather low) required reserves.

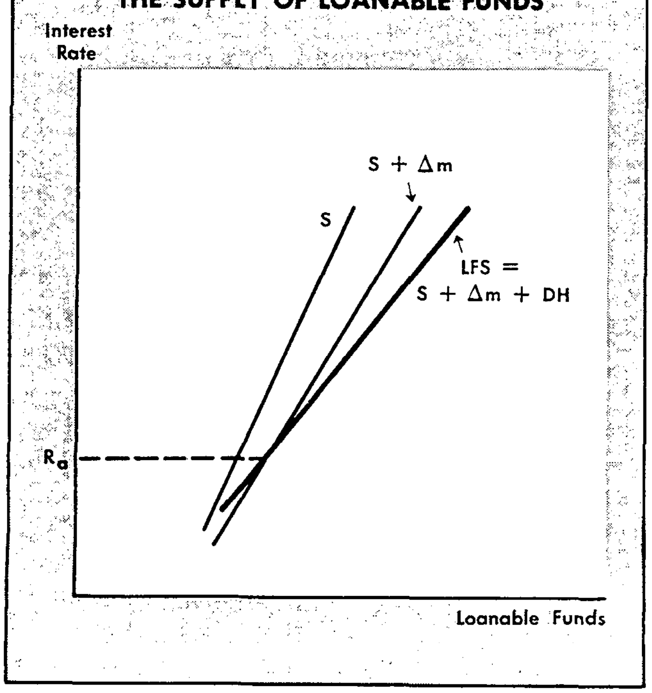
The increased supply of loanable funds Δm is a multiple of any increase in reserves through the well-known credit multiplier. The size of this multiplier is sensitive to changes in the public's desire to hold time and savings deposits, increasing markedly when these deposits are an important form of the public's wealth holding.[7]

The supply of loanable funds also varies with the public's demand for money. For example, financial innovations such as credit cards lower the public's demand for cash and demand deposits. The supply of loanable funds increases when the public desires to exchange M1 balances for financial claims. Such an exchange of M1 for financial claims is known as dishoarding and results in a higher ratio of income to money, or higher velocity, for the economy. This increase in the supply of credit is represented by an increase in the horizontal distance between S and the total supply of loanable funds in Figure 2—the distance DH. (Below some low interest rate level, such as R_a in Figure 2, the public will prefer additional liquidity rather than the inconvenience of low-yielding financial claims and will hoard.)[8] The sum of savings S, changes in credit flows Δm, and net dishoarding DH defines the total supply of loanable funds—the LFS curve in Figure 2.

Interest Rate Determination As in other markets, the price of loanable funds is determined by the intersection of supply and demand. With income held constant, the market for loanable funds may be represented in Figure 3 by LFD, the demand; LFS, the supply; and R_f, the equilibrium price or interest rate. The quantity of loanable funds offered and accepted is Q_f.

Figure 2

THE SUPPLY OF LOANABLE FUNDS



[6] See Alfred Broaddus, "Aggregating the Monetary Aggregates: Concepts and Issues," *Economic Review*, Federal Reserve Bank of Richmond, (November/December 1975), pp. 3-12.

[7] Changes in credit can be several times the amount of the change in high-powered money. One version of the *potential* credit expansion multiplier is defined "if the public holds demand deposits, currency, and [time and savings deposits] in the proportions 1:c:t . . . the combined acquisition of credit instruments by banks and intermediaries" would be:

$$\frac{1 + c + t}{r_d + c + (r_t + r_d r_s)t} \quad X$$

where X is excess reserves available to support credit expansion, r_d is the reserve requirement for demand deposits, r_t is the reserve requirement for time and savings deposits held at the central bank, and r_s is the subjective "reserve requirement" for intermediary deposits held in demand deposits of commercial banks. The larger the proportion of time and savings deposits, particularly those of nonbank intermediaries, that the public desires to hold, the larger the potential multiplier. Warren L. Smith, "Financial Intermediaries and Monetary Controls," *Quarterly Journal of Economics* (November 1959), pp. 533-53.

[8] The treatment of *net* dishoarding as an addition to the supply of loanable funds is based on the increase in the velocity of M1 shown later. Dennis H. Robertson, "Mr. Keynes and the Rate of Interest," in *Readings in the Theory of Income Distribution*, ed. by William Fellner and Bernard F. Haley (Philadelphia: Blakiston, 1946).

High velocity, one consequence of high interest rates, dampens them in the next time period. See John Kraft and Arthur Kraft, "Income Velocity and Interest Rates," *Journal of Money, Credit and Banking* (February 1976), pp. 123-5.

The Crowding Out Effect The loanable funds framework is well suited to the analysis of crowding out. This concept refers to the displacement of private borrowings by Federal deficit financing. Repeating the previous schedules in Figure 4, at the rate R_f Federal deficit financing at the level FD and private investment financing at the level I_1 occur. Suppose that the Federal deficit increases to FD′. The demand for loanable funds shifts rightward to LFD′ by the increase in the deficit. If the supply of loanable funds schedule remains constant, the interest rate increases from R_f to R_2. The Federal sector borrows FD′ despite the higher interest rate structure. But the higher rate R_2 depresses business investment. *If* income and the state of investor confidence remain unchanged, investment capital funds decline from I_1 to I_2.

The fall in investment will not usually equal the rise in Federal borrowings. The extent of the crowding out depends on the elasticity and position of the I curve. If investment is highly interest elastic, capital expenditures will decline markedly. If investment is fairly insensitive to interest rates, most planned capital expenditures will continue to be made. In the example of Figure 4, private capital funds declined by less than the increase in deficit financing. At the higher rate R_2 the total supply of loanable funds increased to Q_2; the larger deficit then displaced $(Q_2 - Q_f)-(FD' - FD) = (I_1 - I_2)$ of private sector funds. In any case, the rise in interest rates is one indicator of the resulting pressures on private capital expenditures.

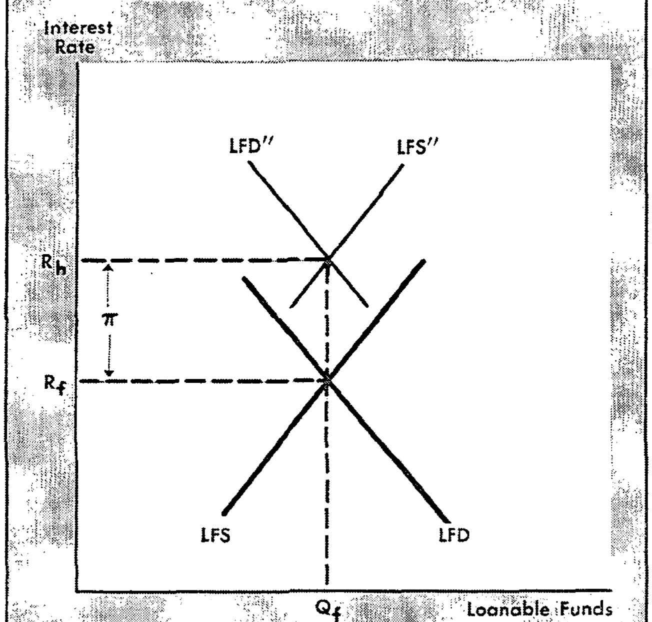
If the deficit is successful in raising income during a depression, investment spending may not be excessively depressed. But when income rises, this rightward shift in LFD reinforces the rise in interest rates. Investment will be dampened over time.

An additional effect of deficit financing on the state of investor confidence that influences the position of the I curve has been hypothesized. For example, in one Keynesian model,

> . . . under conditions of a budget deficit there exists an inverse relationship between investment and [the change in Government bonds]. . . . [the] appearance of public hostility and fear of deficit spending (adverse expectations) can, in theory, profoundly interfere with the stimulative capacity of the fiscal action causing the deficit. At the extreme, a perverse result, i.e., a negative spendings multiplier . . . might even be obtained.[9]

Figure 3

INTEREST RATE DETERMINATION



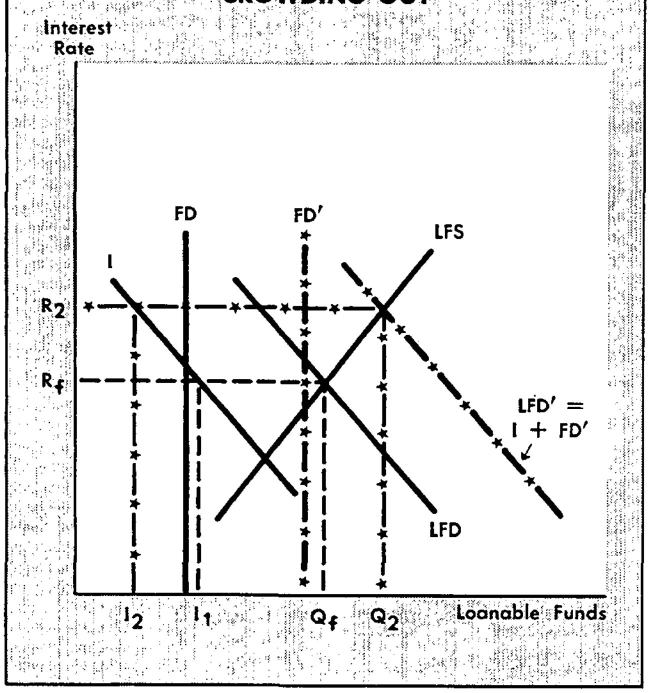
Inflation While the above analysis assumed a noninflationary economy, the loanable funds framework is well suited to the analysis of inflation and financial markets. Inflation erodes the purchasing power of loanable funds. When this loss of purchasing power is subtracted from the nominal rate, the real rate of interest is obtained. This real rate equals the nominal rate only when prices remain constant. If, for example, the interest rate is 7% when the price level is rising steadily at 4%, the real rate is 3%.

Most loanable funds theorists, following Irving Fisher, assume that borrowers and lenders react symmetrically to anticipated inflation. Borrowers recognize that they will repay their debts in cheaper dollars. The productivity of investment in nominal terms rises by exactly the anticipated rate of inflation. Similarly, lenders recognize that they will receive debt repayments in less valuable dollars. Their real reward for saving declines by the anticipated rate of inflation. Under these assumptions, the demand for funds would shift upward to the right by the expected rate of inflation, while the supply of funds would shift upward to the left by the same amount. The nominal rate of interest would rise by exactly the amount of expected inflation. Neither the real rate nor the quantity of credit flows would vary with inflation. This hypothetical situation is

[9] Richard J. Cebula, "Deficit Spending, Expectations, and Fiscal Policy Effectiveness," *Public Finance* (1973), pp. 365-6.

Figure 4

CROWDING OUT



illustrated in Figure 3.[10] The LFD″ and LFS″ curves fully embody the rate of inflation π (R_h minus R_f). The quantity of loanable funds flowing through credit markets remains Q_f.

The true relation between inflation, the nominal rate, and the real rate is, however, more complex than in the above scenario. Both nominal and real rates are affected by asymmetrical inflation-induced shifts in LFD and LFS.

Inflation stimulates LFD, as is well known. It enhances the nominal dollar returns available from current investment. Future output can be sold at higher dollar prices. Moreover, physical investments made today should be less costly than those made in the future, when their prices are expected to be higher. The probability of capital gains from selling capital assets then rises.

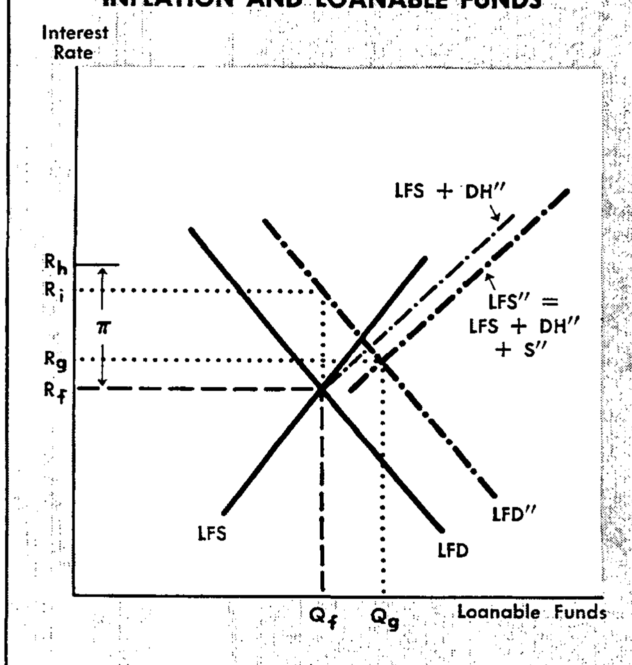
Inflation also raises expected wages. Employees demand protection of their standard of living through higher nominal wages. Minimum wage levels are raised in response to the inflation, reinforcing the rise in labor costs by setting ever-higher floors underneath wages. Employers then attempt to substitute capital for labor. The investment demand curve increases under inflationary conditions, not only because expected debt repayment will be in cheaper dollars, but also because the productivity of new capital rises.[11]

The total demand for loanable funds may not increase by the full extent of the anticipated inflation, however. Some users of capital find that their borrowing capacity cannot keep pace with the total cost of capital investment. These users, such as price-regulated utilities, many potential home buyers, and some state and local governments, may find that they are priced out of the capital market. They are very sensitive to the nominal rate of interest, as well as to the non-interest cost of capital investment. Moreover, Federal deficit financing should not be stimulated by inflation in the short run. LFD thus shifts upward by an amount *less than* the inflation. In Figure 5, the demand for loanable funds will shift to a position such as LFD″ if a rate of inflation π is anticipated based on actual inflation. Borrowers as a group would pay R_i to obtain the pre-inflation quantity of funds Q_f.

Inflation also affects the supply of loanable funds, but not in the manner prescribed by Fisherian loanable funds theory. As discussed earlier,

Figure 5

INFLATION AND LOANABLE FUNDS



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[10] Donald J. Mullineaux, "Inflation Insurance: An Escalator Clause for Securities," *Business Review*, Federal Reserve Bank of Philadelphia, (October 1972), pp. 11-12.

[11] The demand for external finance will increase even when persistent inflation lowers the return on existing capital investment. John Lintner, "Inflation and Common Stock Prices in a Cyclical Context," in *Annual Report*, (New York: National Bureau of Economic Research, 1973), pp. 23-36; and Lintner, "Inflation and Security Returns," *Journal of Finance* (May 1975), pp. 259-80.

that theory would have LFS shift upward to the left in response to inflation. As will be shown, however, the supply of loanable funds actually shifts to the right in response to inflation. While this reaction may not occur in a hyperinflationary economy, it has occurred in recent American experience.

Clearly, inflation reduces the expected future value of present cash holdings. Wealth holders attempt to reduce their M1 balances when inflation "taxes" the value of their money holdings. This dishoarding increases the supply of funds available to purchase interest-bearing financial assets that are partially protected against inflation by nominal interest payments.[12] LFS shifts to the right by the distance DH″ in Figure 5. The partial supply of loanable funds curve (LFS + DH″) increases more rapidly as higher inflation is expected to deplete the value of M1.

Moreover, inflation increases the uncertainty of expected future real income streams. Most people feel that a high rate of actual inflation, particularly if it exceeds a "normal" rate of inflation, indicates that their future expenses will increase more rapidly than their future incomes. This feeling is particularly rational when (1) cost-push inflation is imported from abroad through cartelized commodities or devaluations and (2) inflation shifts individuals into higher income tax brackets and raises other taxes. Most individuals feel that they cannot raise their income to match these uncontrollable increases in the cost of living. Furthermore, the probability of complete income compensation for inflation decreases as the rate of inflation increases. Even *if* the prospect of higher real income appears as likely as the prospect of lower real income during inflations, the resulting increased variance of expectations of real earnings decreases the confidence with which most people view the future. To hedge against this uncertain future, less-confident consumers *increase* their rate of current saving.[13] Contrary to the conventional wisdom, consumers then save by reducing their spending on purchases of durable goods—automobiles and household furniture and fixtures.[14] If the inflation is unanticipated, consumers may even reduce their expenditures on nondurable goods and services to increase their savings.

In addition, the desire of most individuals to protect the capitalized value of their earning asset holdings stimulates saving behavior when interest rates rise during inflationary periods. The real value of portfolio earning assets declines in inflationary periods, not only because the earnings expected from capital are received in depreciated dollars, but also because the rate of discounting of this earnings stream—the "pure" rate of interest plus a premium for assuming financial risk—also rises.[15] This wealth effect, which dampens consumption and stimulates saving, is not balanced out by net debtors feeling wealthier in real terms during an inflation. Most debt is owed by businesses and governments, whose real wealth position does not directly enter into most individuals' evaluation of their personal portfolio positions.

Finally, inflation does not directly diminish the very large supply of funds that institutional investors provide to credit markets. The purchasing power of money is not an important factor in the investment decisions of bank and nonbank institutions whose liabilities are measured in dollars. They seek the highest "prudent" nominal rate of return from their financial assets once the size of their portfolios is determined.[16]

A large body of empirical evidence confirms this form of saving behavior in the American

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[12] Dean S. Dutton, "The Demand for Money and the Expected Rate of Price Change," *Journal of Money, Credit and Banking* (November 1971), pp. 861-77; Robert A. Mundell, "A Fallacy in the Interpretation of Macroeconomic Equilibrium," *Journal of Political Economy* (February 1965), pp. 61-6; Mundell, "Inflation and Real Interest," *Journal of Political Economy* (June 1963), pp. 280-3; Lester D. Taylor, "Price Expectations and Households' Demand for Financial Assets," *Explorations in Economic Research* (Fall 1974), pp. 258-399.

[13] F. Thomas Juster and Paul Wachtel, "Inflation and the Consumer," *Brookings Papers on Economic Activity* (No. 1, 1972), pp. 71-121; Hayne E. Leland, "Saving and Uncertainty: The Precautionary Demand for Saving," *Quarterly Journal of Economics* (August 1968), pp. 465-73; Agnar Sandmo, "The Effect of Uncertainty on Saving Decisions," *Review of Economic Studies* (July 1970), pp. 353-60.

[14] The large expenditures on consumer durable goods in 1972-73 stemmed partly from the artificial restraint on their prices dictated by price controls. These prices were expected to rise rapidly when controls would be removed.

[15] Financial wealth can be defined as:

$$W = M + \frac{B}{r} + \frac{E}{\rho}$$

where W is wealth, M is the quantity of money, B is the quantity of bonds expressed in terms equivalent to perpetual bonds with a $1 coupon, r is the current market interest rate, E is the expected earnings stream from real capital, and ρ is the market-determined rate of discount for profits. Deflating all terms by the price level defines "real" financial wealth. Joseph R. Bisignano, "The Effect of Inflation on Savings Behavior," *Economic Review*, Federal Reserve Bank of San Francisco, (December 1975), p. 21.

It can be shown that when inflation raises the nominal rate of discount r for riskless bonds, it increases the nominal rate of discount ρ for risky financial investments to an even greater extent. The prices of equities fall with the resulting increase in perceived financial risk, as well as with the increase in required return due to higher interest rates.

[16] Lintner, Thomas Piper, and Peter Fortune, "Investment Policies of Major Financial Institutions Under Inflationary Conditions," in National Bureau of Economic Research, *op. cit.*, p. 98.

economy during recent inflations.[17] Inflation shifts the savings schedule (given income) by a distance S″ in Figure 5; inflation does *not* decrease it. The supply of loanable funds schedule increases from LFS to LFS″ (LFS + DH″ + S″) in an inflationary climate typical of recent experience.

Under these conditions the demand for funds exceeds the supply of funds at the no-inflation interest rate R_f. With this excess demand for credit, the nominal rate of interest rises to R_g. But R_g is less than R_f plus the inflation rate π; the real rate of interest clearly declines. This lower real rate increases desired investment along LFD″.[18]

Inflation stimulates financial flows: loanable funds flowing through financial markets rise from Q_f to Q_g in Figure 5. The greater flows of funds are associated with an incomplete adjustment of the nominal interest rate to inflation. The dishoarding and saving adjustments to inflation, increases in the supply of credit by financial institutions, and the inability of some borrowers to adapt to inflation prevent the full adjustment of LFD and LFS to experienced inflation in a period less than the very long run. Only then could all desired income and portfolio adjustments to presumably fully anticipated inflation be made.

Loanable Funds Theory and Predicting Interest Rates The loanable funds theory can be stated in equation form. The demand for loanable funds is:

$$(1) \quad LFD = I + FD = I(r, Y, \pi) + \overline{FD}$$

where the investment demand for funds varies inversely with interest rate r—a real rate—and positively with income Y and anticipated inflation π.[19] The Federal deficit FD is assumed to be exogenous.

The supply of loanable funds is:

$$(2) \quad LFS = S + \Delta m + DH = S(r,Y,\pi) + \overline{\Delta m} + DH$$

where savings vary positively with the real rate, income, and anticipated inflation. Changes in credit Δm based on changes in money are treated as exogenous in the short run. The inclusion of the dishoarding term is discussed later (p. 21).

To solve for the nominal interest rate, subtract equation (2) from equation (1) and collect terms. The resulting relationship shows the determinants of interest rates.

Nominal and real rates increase when the Federal Government runs a deficit and when the money supply falls. Nominal and real interest rates rise when real output increases if the income-induced investment exceeds the income-induced saving. Nominal interest rates rise during inflationary periods if investment demand rises more than the supply of savings plus dishoarded money. Finally, the theory developed above postulates that real rates fall during inflations.

A number of previous studies of the determinants of rates were reviewed before completely specifying the equations to test the loanable funds theory.[20] The results of these studies are generally consistent with the loanable funds framework, but they contain enough contradictory findings to warrant a new investigation.

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[17] The saving rate is significantly related to measured uncertainty in the economy. For example, from 1962 I through 1975 II, personal savings/disposable personal income was correlated −0.68 with the Survey Research Center Index of Consumer Sentiment. This Index was correlated −0.79 with the rate of inflation. Correspondingly, the personal saving rate was correlated 0.54 with the annualized rate of change in the Consumer Price Index over this period.

More extensive confirmation of these relationships is provided by: Susan W. Burch and Diane Werneke, "The Stock of Consumer Durables, Inflation and Personal Saving Decisions," *Review of Economics and Statistics* (May 1975), pp. 141-54; Saul H. Hymans, "Consumer Durable Spending: Explanation and Prediction," *Brookings Papers on Economic Activity* (No. 2, 1970), pp. 173-99; Juster and Taylor, "Towards a Theory of Savings Behavior," *American Economic Review* (May 1975), pp. 203-24; Juster and Wachtel, *loc. cit.;* George Katona, *Psychological Economics* (New York: Elsevier, 1975); William Poole, "The Role of Interest Rates and Inflation in the Consumption Function," *Brookings Papers on Economic Activity* (No. 1, 1972), pp. 211-20; Burkhard Strumpel *et. al.*, (eds.), *Human Behavior in Economic Affairs* (San Francisco: Jossey-Bass, 1972); Taylor, "Price Expectations;" and Taylor, "Saving Out of Different Types of Income," *Brookings Papers on Economic Activity* (No. 2, 1971), pp. 383-415.

[18] William P. Yohe and Dennis S. Karnosky, "Interest Rates and Price Level Changes, 1952-69," *Review*, Federal Reserve Bank of St. Louis, (December 1969), pp. 18-38; A. John Steigmann, "On Inflation and Interest Rates," *Business Economics* (May 1975), pp. 72-3.

[19] Smith, "Monetary Theories of the Rate of Interest: A Dynamic Synthesis," *Review of Economics and Statistics* (February 1958), pp. 15-21; Tsiang, *loc. cit.*

[20] Leonall C. Andersen and Keith M. Carlson, "An Econometric Analysis of the Relation of Monetary Variables to the Behavior of Prices and Unemployment," in *The Econometrics of Price Determination*, ed. by Otto Eckstein (Washington: Board of Governors of the Federal Reserve System, 1972), pp. 166-83; J. A. Cacy, "Budget Deficits and the Money Supply," *Monthly Review*, Federal Reserve Bank of Kansas City, (June 1975), pp. 3-9; G. Marc Choate and Stephen H. Archer, "Irving Fisher, Inflation, and the Nominal Rate of Interest," *Journal of Financial and Quantitative Analysis* (November 1975), pp. 675-85; Donald M. DePamphilis, "Long-term Interest Rates and the Anticipated Rate of Inflation," *Business Economics* (May 1975), pp. 11-18; Echols and Elliott, *loc. cit.;* Feldstein and Chamberlain, *loc. cit.;* Feldstein and Eckstein, "The Fundamental Determinants of the Interest Rate," *Review of Economics and Statistics* (November 1970), pp. 363-75; William E. Gibson, "Interest Rates and Monetary Policy" in *Monetary Economics*, ed. by Gibson and George G. Kaufman (New York: McGraw-Hill, 1971), pp. 311-29; Gibson, "Price-Expectations Effects on Interest Rates," in Gibson and Kaufman, *Ibid.*, pp. 339-51; Gibson and Kaufman, "The Sensitivity of Interest Rates to Changes in Money and Income," *Journal of Political Economy* (June 1968), pp. 472-8; Stephen M. Goldfeld, *Commercial Bank Behavior and Economic Activity* (Amsterdam: North-Holland, 1966); Michael J. Hamburger and William L. Silber, "An Empirical Study of Interest Rate Determination," *Review of Economics and Statistics* (August 1969), pp. 369-81; Hunt, *loc. cit.;* Thomas J. Sargent, "Commodity Price Expectations and the Interest Rate," in Gibson and Kaufman, *op. cit.*, pp. 330-8; Robert H. Scott, "Liquidity and the Term Structure of Interest Rates," *Quarterly Journal of Economics* (February 1965), pp. 135-45; Silber, *Portfolio Behavior of Financial Institutions* (New York: Holt, 1972); and Yohe and Karnosky, *loc. cit.*

Interest Rate Equations The empirical findings of previous studies and the loanable funds theory outlined above suggest equations for estimating nominal interest rates of the form:

$$(3)\quad RATE_t = CON + a\dot{M}_t + bY_{t-1} + \sum_{i=0}^{n} c_i FD_{t-i} + \sum_{i=0}^{n} d_i \dot{P}_{t-i}$$

where the following coefficient values are anticipated:

$$CON > 0,\ a<0,\ b>0,\ \Sigma c_i>0,\ \Sigma d_i>0.$$

The time subscript t refers to monthly observations. RATE is the nominal rate. The constant term CON captures the effects of any influences that are not explicitly considered, such as a tendency for rates to assume some "normal" level. The annualized rate of growth of money $\dot{M}$ is the foundation upon which resulting larger credit changes Δm are based. The lagged unemployment rate serves as an inverse proxy for the level of real output Y. This closely watched coincident indicator reflects excess demand in the labor and product markets. It reflects the difference between actual output and capacity output.[21] It is also associated with the state of investor confidence in the economy.[22] Moreover, since it is not defined in monetary units, it should not be subject to inflationary distortions of measurement. Unlike personal income, which includes transfer payments and which tends to increase despite industrial fluctuations, the unemployment rate should reflect variations in real GNP, which is not available on a monthly basis. The exogenous Federal deficit FD should affect the economy with a lag. Similarly, the annualized rate of price change $\dot{P}$ should affect financial markets over a long period. These lags are based on investor reactions to trends in these volatile series, reflecting delayed incorporation of information into expectations. The necessity of incorporating a dishoarding term into equation (3) requires a slight digression on the definition of money.

[21] Through Okun's Law, "the unemployment rate can be viewed as a proxy variable for all the ways in which output is affected by idle resources." Arthur M. Okun, "Potential GNP: Its Measurement and Significance," *Proceedings of the Business and Economic Statistics Section*, American Statistical Association (1962), p. 99. Andersen and Carlson, *loc. cit.;* Gary Smith, "Okun's Law Revisited," *Quarterly Review of Economics and Business* (Winter 1975), pp. 37-54.

[22] It is highly related to the Index of Consumer Sentiment, for example. See the references in footnote 17, and Dwight M. Jaffee, "Cyclical Variations in the Risk Structure of Interest Rates," *Journal of Monetary Economics* (1975), pp. 309-25.

Which Monetary Aggregate Influences Interest Rates? There has been much discussion in recent years concerning the proper definition of money. Of the various aggregates suggested, the riskless and highly liquid M1, M2, or M3 seems appropriate in the loanable funds model. Broader aggregates incorporate credit instruments themselves, which are subject to risk of default if less than AAA quality and which are subject to capital loss of varying extent if interest rates rise. These securities are generally either illiquid (U. S. savings bonds) or beyond the reach of most individuals (commercial paper, Treasury bills). Any of these three behaviorally appropriate aggregates could be used as the money variable in this model. The question is, which one of these measures influences interest rates most strongly.

One answer to this question emerges from the relationship between changes in these aggregates and credit flows. New M1, flowing through the banking system, was 8.2 percent of total funds advanced in credit markets from January 1967 through December 1975. The more rapidly growing new M2 was 23.6 percent of these funds. And explosively growing new M3, flowing through nonbank depository institutions as well as through banks, accounted for 40.7 percent of the credit market funds advanced in this period. This evidence suggests that growth in M3 is more closely related to the change in the supply of credit than growth in M1 or M2.[23]

A second answer emerges from the velocity of these monetary aggregates. Dishoarding of M1 has occurred in recent years. The income velocity of M1 increased secularly from 4.3 in the fourth quarter of 1966 to 5.3 in the fourth quarter of 1975. The income velocity of M2, however, remained remarkably constant during this period. It was 2.4 in the fourth quarter of 1966 and 2.4 in the fourth quarter of 1975. The income velocity of M3 varied slightly around its beginning and ending value of 1.5 during this period.

Inflation, institutional factors such as changes in the payments mechanism, and increasing activity by nonbank financial institutions have evidently lessened the traditional role of M1. This shift away from desired holdings of M1, particularly from currency, into interest-bearing deposits stimulates the supply of loanable funds through reduced reserve ratios and the correspondingly higher potential loan/deposit ratios. Many sav-

[23] The calculations in this and the following paragraph are based on *Flow of Funds* data. See footnote 4 for references.

ings and loan associations have loan/deposit ratios greater than unity, for example.[24]

The considerations that money should behave as a medium of exchange for goods and services with a fairly constant velocity and that it should serve as a store of *real* purchasing power (at least partly protected against inflation by interest payments), suggest that the growth of M2 and M3 may serve as better indicators of liquidity than the growth of M1. Essentially zero dishoarding of M2 and M3, as indicated by their stable velocity in recent years, correspondingly suggests that the DH term is not required in empirical interest rate equations.

Methodology The extent to which the basic economic influences of income, inflation, deficit spending, and changing credit flows influence interest rates may vary with the quality and term to maturity of various securities. To what extent do the short- and long-term, new issue or seasoned, taxable and tax-free, and risky and riskless characteristics of securities alter the response of their interest rates to fundamental economic factors? To study these questions, equations of the form (3) were estimated for the following rates: the 3-month new issue Treasury bill rate, Moody's 3-5 year U. S. Government securities rate, Moody's Industrial A seasoned long-term bond rate, Moody's new issue Municipal A rate, and the long-term Government bond rate reported by the Federal Reserve.

The equations are estimated on a monthly basis from December 1966 through December 1975. Since the analysis is concerned with short-run interest rate responses to economic factors, the maximum time lag is limited to twelve months.

Economic Interactions: The Fed's Dilemma Interactions among fiscal policy, inflation, money, and unemployment over longer periods reduce the ability of single-equation models to identify causality. In particular, financing the Federal deficit involves the indirect purchase ("monetization") of part of the resulting Federal debt by the central bank. This causes the money stock to rise. The resulting excess supply of money may create later excess demand in the commodity market, as well as current excess demand in the credit market, and lead to subsequent inflation. The monetary authority thus faces a cruel dilemma when extensive deficit financing occurs. Should the money supply increase enough to cushion the decline in investment in the current period, it may generate inflation later. If monetary growth is large enough to hold down current nominal interest rates despite the deficit financing, it may raise inflationary expectations and interest rates in the future. If money does not increase enough to allow most planned investment to be made, future productive capacity will be markedly lower than it would have been without the deficit. This condition of lower-than-otherwise output may result in shortages and future inflation. Interest rates may then rise to high levels unless the demand for goods and services falls.

Interest Rate Equations The estimated relationships of interest rates to Federal deficits, inflation, monetary growth, and unemployment are reported in Appendix Tables I and II. Appendix A discusses their technical aspects in detail. For the general reader, the empirical results may be summarized briefly. While the equations estimate nominal rates, realized real rates may be implied from the lagged coefficients on the inflation rate. If yearly inflation terms are less than unity, *ex post* real rates tend to decline.

Chart 1 illustrates the effectiveness of the interest rate equations in matching actual events in the sample period. In the chart actual rates appear as solid lines, and rates predicted *ex post* appear as dashed lines. These equations explain 92 to 99 percent of the variation in interest rates over the period. (The predicted rates tend to lag very slightly behind actual rates, as would be expected from their use of lagged predictors.) The predicted rates exhibit no secular tendency to over or underpredict actual rates.

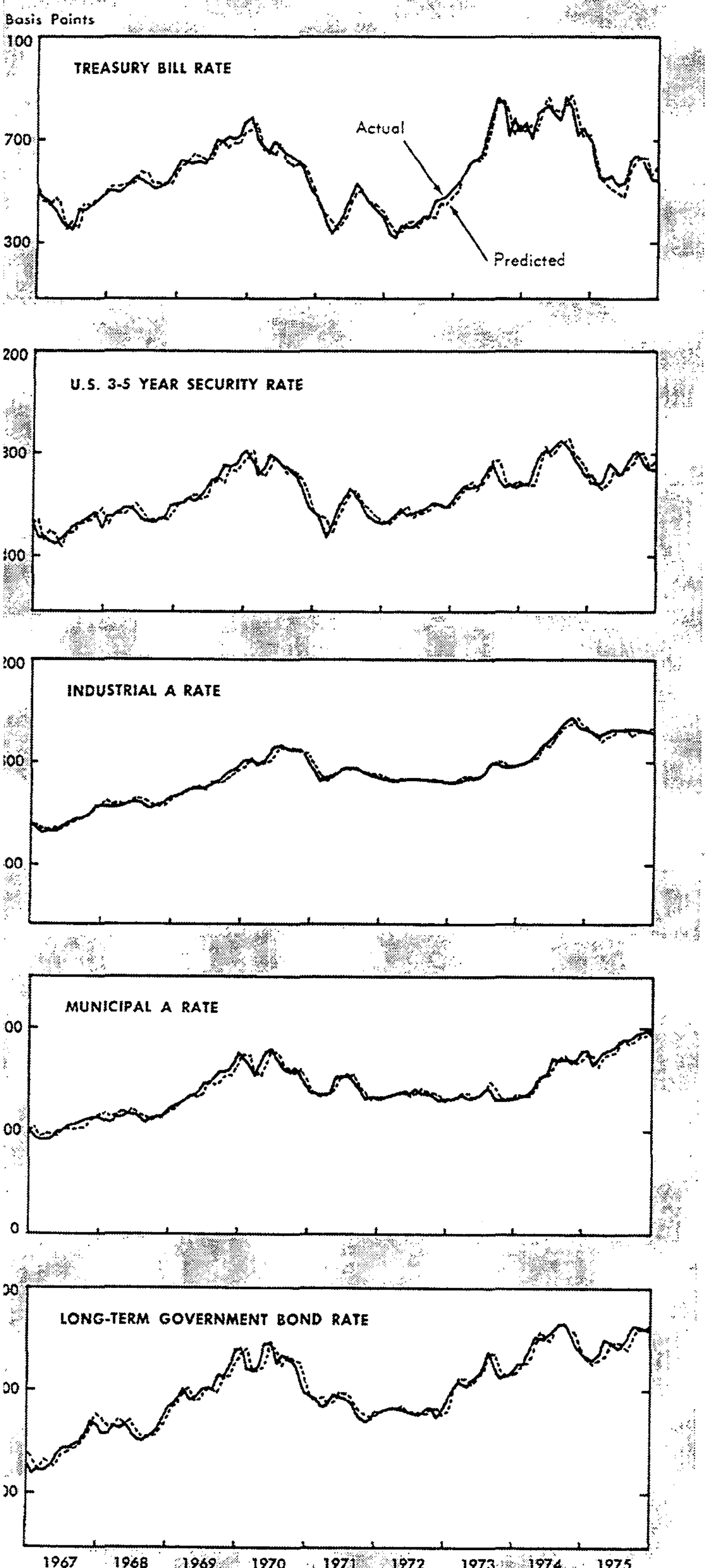
In general, Federal deficit spending increases interest rates with a four- to six-month lag. These deficits generally continue to drive up both Federal and private borrowing costs throughout the remainder of a twelve-month period.

The resulting interest rate pressure is larger, more significant, and more prolonged for the Industrial A and Municipal A rates than it is for the similar maturity long-term Government bond rate. Risk-averse investors in the long-term bond market evidently require a larger "risk premium" on medium-grade private securities when deficit spending reduces their state of confidence. This rise in interest rates restricts the effectiveness of

[24] See footnote 7 and the other loanable funds credit multipliers shown in Smith, "Financial Intermediaries." A shift from currency into nonbank deposits could increase loanable funds by almost four times the amount of the shift in Smith's analysis.

Chart 1

ACTUAL VERSUS PREDICTED INTEREST RATES



Sources: Federal Reserve Bulletin; Moody's Industrial Manual.

the deficit in raising income.[25] This evidence supports the view that crowding out, measured indirectly through interest rates, has occurred to some extent in our economy in recent years.

Inflation stimulates nominal rates very significantly, with both current period and lagged effects. The Treasury bill rate, for example, reacts strongly to inflation: approximately half of the impact of a sustained rate of inflation appears in this rate over a ten-month period. Recent inflation encourages inventory building, resulting in heavy demand for bank loans and commercial paper. This puts upward pressure on all short-term rates, including the Treasury bill rate. Longer-term rates, however, adapt less strongly to inflation. The 3-5 year Treasury note, Industrial A, and Municipal A rates embody less than one-quarter of realized inflation rates within a year. When inflation occurs, the Industrial A rate reacts very rapidly, while the U. S. 3-5 year security rate reacts more slowly, and the Municipal A rate generally takes still longer to respond. The long-term Government rate incorporates only about one-eighth of the actual inflation rate during a twelve-month period.

These findings are consistent with the inflation-induced shifts in the supply and demand curves of the loanable funds theory above. Real rates fall when the price level increases rapidly, although to a different extent for each rate. The length of the period of past inflation that real-asset investors use to anticipate inflation over the period of their borrowing should be positively related to the length of the borrowing contract.

Increasing the rate of monetary growth lowers interest rates. But the effects of varying growth rates of money are erratic or insignificant in equations that examine them for lagged time periods.[26] Growth in M3 lowers rates more than growth in M2. In turn, growth in M1 lowers rates to a still lesser extent, sometimes not significantly. Monetary growth is more important for shorter rates than for longer ones. Appendix B examines these liquidity effects in more detail.

Realized income has the influence on interest rates that theory suggests. High unemployment, typifying weak private sector excess demand (investment minus savings) for credit, lowers all

[25] Carlson and Roger W. Spencer, "Crowding Out and Its Critics," *Review*, Federal Reserve Bank of St. Louis, (December 1975), pp. 2-17; Spencer and Yohe, "The Crowding Out of Private Expenditures by Fiscal Policy Actions," *Review*, Federal Reserve Bank of St. Louis, (October 1970), pp. 12-24.

[26] Similar results appear in Gibson, "Interest Rates and Monetary Policy," *loc. cit.*

five interest rates.[27] Current business conditions affect shorter-period rates more than longer-period ones.

Finally, the constant terms incorporate the effects of other factors that are not explicitly considered. For example, the constant in the Municipal A rate equation is more than 100 basis points below the constant in the similar quality Industrial A rate equation. The income tax exemption for municipal bonds is an important determinant of this difference between intercepts.

The longer-term equations have better explanatory ability than the Treasury bill and U. S. 3-5 year note equations. Near-term expectations of institutional factors play a larger role in shorter-term than longer-term markets. Nonetheless, these equations provide an operational specification of the effects of fundamental economic forces on financial markets. These results, when supplemented by other factors and informed judgment, may provide a useful framework for predicting interest rates.

[27] It is not significant in the Industrial A equation. The simple correlation between lagged unemployment and the Industrial A rate is 0.71, suggesting that unemployment reduces investor confidence in these slightly risky securities. The confidence effect evidently almost overcomes the income effect for this rate. See William D. Jackson, *Determinants of Long-Term Bond Risk Premiums*, Federal Reserve Bank of Richmond, (1976).

APPENDIX A

AN ECONOMETRIC EXPLANATION OF INTEREST RATES

Appendix Tables I and II present the estimating equations for the five interest rates. The rates are measured in basis points (100 basis points equal one percent). The growth rates of money are given as revised seasonally adjusted annual rates. The unemployment rate is expressed as a seasonally adjusted percentage. The Federal budget deficit is expressed in units of $trillions/10. A surplus is indicated by a negative value, while the more typical deficit is indicated by a positive figure. The inflation rate is defined as the annualized rate of change of the consumer price index.

The distributed lags on Federal deficits and inflation employ the smoothing technique of third-degree Almon polynomial approximation without constraints on beginning or ending values. This technique finds a time response

Appendix Table I

STATISTICAL CHARACTERISTICS OF ESTIMATED INTEREST RATE EQUATIONS

Equation Statistics	Treasury Bill Rate		U. S. 3-5 Year Security Rate		Industrial A Bond Rate		Municipal A Bond Rate		Long-term Government Bond Rate	
	Coefficient	t Statistic	Coefficient	t Statistic	Coefficient	t Statistic	Coefficient	t Statistic	Coefficient	t Statistic
Predictor										
M3 Growth Rate (t)	−6.4509	−4.21	−4.7622	−3.71	−2.1123	−3.76	−2.0967	−2.22	−1.1516	−1.66
Unemployment Rate (t−1)	−54.2917	−3.62	−25.0579	−1.77	−0.2153	−0.03	−13.8815	−1.29	−11.4576	−1.44
Federal Deficit (Sum of Coefficients t to t−11)*	1470.5396	1.11	1653.1787	1.26	1168.5569	1.87	1956.4399	1.87	888.9832	1.15
Inflation Rate (Sum of Coefficients t to t−11)*	46.7221	5.91	23.6375	2.49	22.4733	4.69	18.8627	2.34	12.7252	2.15
Constant	629.9043	8.96	682.9395	7.32	679.8755	12.82	570.9873	6.41	624.8027	9.52
$\bar{R}^2$	0.9412		0.9187		0.9863		0.9549		0.9541	
Standard Error	34.23		29.45		13.02		21.86		16.10	
Durbin-Watson	1.90		1.71		1.26		1.54		1.64	
ρ	0.8493		0.9244		0.9609		0.9660		0.9573	
Mean of Dependent Variable	575.7180		647.4338		758.1765		563.5535		603.5989	

* Individual distributed lag coefficients are shown in Appendix Table II.

Appendix Table II

DISTRIBUTED LAG COEFFICIENTS FOR INTEREST RATE EQUATIONS

Time Lag	Treasury Bill Rate		U. S. 3-5 Year Security Rate		Industrial A Bond Rate		Municipal A Bond Rate		Long-term Government Bond Rate	
	Federal Deficit	Inflation Rate	Federal Deficit	Inflation Rate	Federal Deficit	Inflation Rate	Federal Deficit	Inflation Rate	Federal Deficit	Inflation Rate
t	−57.4630	3.8679	37.5810	1.2608	89.7999	1.4806	28.4906	1.1662	−29.3344	1.1606
	(−0.41)*	(3.15)	(0.30)	(1.19)	(1.61)	(3.17)	(0.30)	(1.49)	(−0.42)	(2.01)
t−1	−3.1176	4.6892	−8.1634	1.1932	47.5372	1.2841	3.1411	0.5053	3.1280	0.7233
	(−0.02)	(3.64)	(−0.06)	(1.00)	(0.79)	(2.36)	(0.03)	(0.55)	(0.04)	(1.07)
t−2	53.9294	5.3250	−10.5670	1.3638	28.6808	1.3210	15.9055	0.2860	37.4223	0.5914
	(0.35)	(3.67)	(−0.07)	(0.98)	(0.43)	(2.04)	(0.14)	(0.26)	(0.46)	(0.74)
t−3	109.5951	5.7489	19.6125	1.6928	28.6467	1.5233	56.4860	0.4099	70.9156	0.6850
	(0.69)	(4.08)	(0.13)	(1.20)	(0.42)	(2.28)	(0.49)	(0.37)	(0.84)	(0.83)
t−4	159.7966	5.9345	71.6716	2.1007	42.8509	1.8230	114.5848	0.7789	100.9691	0.9243
	(1.06)	(4.86)	(0.50)	(1.61)	(0.64)	(2.87)	(1.02)	(0.73)	(1.22)	(1.18)
t−5	200.4509	5.8552	134.8705	2.5078	66.7093	2.1520	179.9039	1.2945	124.9479	1.2295
	(1.41)	(5.52)	(0.97)	(2.09)	(1.02)	(3.59)	(1.65)	(1.28)	(1.55)	(1.66)
t−6	227.4750	5.4846	198.4789	2.8345	95.6379	2.4423	242.1455	1.8585	140.2160	1.5206
	(1.62)	(4.93)	(1.45)	(2.32)	(1.48)	(4.03)	(2.24)	(1.83)	(1.76)	(2.03)
t−7	236.7859	4.7962	251.7659	3.0011	125.0527	2.6258	291.0112	2.3725	144.1376	1.7179
	(1.62)	(3.59)	(1.80)	(2.22)	(1.91)	(4.05)	(2.64)	(2.18)	(1.77)	(2.15)
t−8	224.3008	3.7637	284.0007	2.9281	150.3696	2.6345	316.2039	2.7383	134.0768	1.7415
	(1.48)	(2.46)	(1.98)	(2.00)	(2.26)	(3.87)	(2.83)	(2.40)	(1.63)	(2.07)
t−9	185.9368	2.3605	284.4539	2.5357	167.0049	2.4003	307.4258	2.8576	107.3978	1.5115
	(1.23)	(1.52)	(2.03)	(1.77)	(2.58)	(3.67)	(2.83)	(2.60)	(1.35)	(1.87)
t−10	117.6107	0.5602	242.3937	1.7444	170.3742	1.8552	254.3783	2.6320	61.4646	0.9481
	(0.83)	(0.42)	(1.86)	(1.44)	(2.86)	(3.39)	(2.54)	(2.86)	(0.83)	(1.40)
t−11	15.2397	−1.6638	147.0898	0.4746	155.8937	0.9311	146.7636	1.9632	−6.3586	−0.0286
	(0.10)	(−1.33)	(1.12)	(0.44)	(2.64)	(1.97)	(1.48)	(2.47)	(−0.09)	(−0.04)

* The parentheses contain t statistics for the coefficients immediately above.

without constraining the adjustment path to a predetermined shape.[1] The summed coefficients appear in Appendix Table I, while the individual time coefficients appear in Appendix Table II.

The significance of the coefficients is given by their t statistics. An absolute value of t of 1.29 or more indicates a statistically significant relationship. The R^2 statistics have been corrected for degrees of freedom (98).

The Cochrane-Orcutt correction for first-order autocorrelation is used.[2] This technique corrects a common problem in time series analysis: "runs" of successive overprediction and underprediction. Its correction factor for autocorrelation is ρ. The values of ρ indicate that these equations are essentially first-difference transformations reconverted to units of the original variables. This technique is largely effective in removing autocorrelation, as shown by the Durbin-Watson statistic, which is satisfactory for all except the Industrial A and Municipal A equations. Their high R^2s and ability to explain interest rates on a month-by-month basis during recent years suggest that the remaining positive autocorrelation is not a serious problem.

Several variants of these equations were estimated. Substituting the index of industrial production and its changes for the unemployment rate produced insignificant t values for these proxies of income and its change. Anticipatory-expectations proxies for future income, such as the new (deflated) index of leading indicators and stock prices, are so correlated with inflation, monetary growth, and unemployment that they added essentially no new information to the analysis.

[1] Phoebus J. Dhrymes, *Distributed Lags: Problems of Estimation and Formulation* (San Francisco: Holden-Day, 1971); James L. Murphy, *Introductory Econometrics* (Homewood: Irwin, 1973).

[2] Murphy, *loc. cit.*

APPENDIX B

M1, M2, M3, AND INTEREST RATES

Does the increasing use of interest-bearing time and savings accounts as stores of liquidity mean that the growth of M2 and M3 lowers interest rates more than the growth of M1? Alternative versions of the interest rate equations test this hypothesis. The monetary growth coefficients appear in Appendix Table III. All of the other explanatory variables possess the same sign and general significance, whether growth in M1, M2, or M3 represents the $\dot{M}$ term.

Growth in M3 is a more valid indicator of the economy's liquidity than is growth in M1. Growth in M2 indicates the liquidity of the economy to a lesser extent than growth in M3. A traditional indicator of monetary policy, growth in M1 has a weak influence on interest rates in this specification. Its liquidity effect is less than one-quarter of the liquidity effect of M3, falling to insignificance in the Municipal A and long-term Government rate equations. These empirical results suggest that consideration of broader monetary aggregates in the implementation of monetary policy is a proper move on the part of the monetary authority.

Appendix Table III

COEFFICIENTS OF MONETARY GROWTH IN INTEREST RATE EQUATIONS

Growth Rate of	Treasury Bill Rate	U. S. 3-5 Year Security Rate	Industrial A Bond Rate	Municipal A Bond Rate	Long-term Government Bond Rate
M1	−1.1568 (−1.62)*	−1.1013 (−1.75)	−0.5126 (−2.03)	−0.4634 (−1.12)	−0.2350 (−0.77)
M2	−4.6281 (−4.29)	−3.2594 (−3.59)	−1.3622 (−3.41)	−1.6106 (−2.44)	−0.7274 (−1.48)
M3	−6.4509 (−4.21)	−4.7622 (−3.71)	−2.1123 (−3.76)	−2.0967 (−2.22)	−1.1516 (−1.66)

* The parentheses contain t statistics for the coefficients immediately above.

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