Review

Vol. 67, No. 3 March 1985

THE FEDERAL RESERVE BANK of ST. LOUIS

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In This Issue . . .

In the first article in this *Review*, "Why the Big Rise in Business Loans at Banks Last Year?" R. Alton Gilbert and Mack Ott examine the reasons for the unusual pattern of business loans at large commercial banks during the current economic expansion. The authors find that, both before and after the first half of 1984, business loans were growing at rates similar to those for comparable periods in earlier economic expansions. A surge of business loans at large commercial banks during the first half of 1984, however, raised such loans above the level that would have been expected on the basis of past cyclical patterns.

Among the possible explanations for the surge in business loans in the first half of 1984 is the unusually rapid rise in the pace of economic activity during that period; this could have induced an unusually large rise in credit demand by business firms. Gilbert and Ott do not find empirical support for this explanation. Instead, they conclude that the most important factor contributing to the surge of business loans was bank financing of corporate mergers and leveraged buyouts. Unlike the other explanations, both the timing and magnitude of the unusually large amount of mergers and buyouts in early 1984 match up with the surge of business loans.

In the second article in this *Review*, "Money Demand Dynamics: Some New Evidence," Daniel L. Thornton briefly reviews the nature of the three standard dynamic models of money demand adjustment. The author points out that these specifications are not statistically comparable. Instead, he notes that these models should be compared in terms of their conformity with theory and their stability over time. Estimating these specifications for three subperiods between II/1951–II/1984, Thornton finds that (1) all three specifications are sensitive to the specification of the long-run demand for money, (2) none is consistent with theory over all three subperiods and (3) none exhibits temporal stability. He concludes, however, that, since none of these specifications may adequately represent the short-run demand for money when estimated using aggregate data, the results may say little about the instability of money demand.

The prospect of large federal deficits has renewed concerns about the Federal Reserve's ability to conduct independent monetary policy. In the third article in this issue, "The Federal Reserve Reaction Function: Does Debt Growth Influence Monetary Policy?" Richard G. Sheehan offers some evidence on the extent to which the Federal Reserve has altered monetary policy in response to federal deficits.

The relationships between the deficit, the money stock and interest rates depend on the nature of the deficit and the targeting procedures used by the Federal Reserve. The author uses a simple model to show that a policy-induced or structural deficit may lead to higher interest rates under a monetary aggregate targeting strategy or to higher money growth under an interest rate targeting strategy. In contrast, a cyclical deficit, induced by a recession for example, will be accompanied by lower interest rates or slower money growth.

Using a reaction function approach, Sheehan finds evidence that structural deficits led to higher money growth before 1971 when the Federal Reserve tar-

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geted interest rates. Since then, the Federal Reserve has, at least in part, focused on a monetary aggregate target, and there is no evidence that money growth has been influenced by structural deficits. Further, there is no evidence suggesting that higher structural deficits have increased interest rates over any period.

Why the Big Rise in Business Loans at Banks Last Year?

R. Alton Gilbert and Mack Ott

BUSINESS loans at large commercial banks rose sharply in the first half of 1984, after changing little in the first year of the economic recovery from the 1981–82 recession. Many analysts of business and financial data cite the rate of growth of business loans at large commercial banks as an indicator of the pace of economic activity.[1] Given that interpretation, this pattern of business loans would have signaled a sharp acceleration in economic activity in the first half of 1984. Some analysts offer the alternative explanation for the rapid rise in business loans that bank credit was being used on an unusually large scale to finance corporate mergers and leveraged buyouts.[2] This article investigates the empirical support for these alternative explanations.

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[1]See Berry (1984), Heinemann (1984), Jasinowski (1984) and Weiner (1984). In particular, Weiner recounts a banker as emphasizing that

> ...loan demand has been real....It is being used to finance inventory, plants and equipment — not mergers and acquisitions....

[2]See Giordano (1984). Economist Henry Kaufman is quoted by *Business Week* as crediting merger finance for the bulge in loans (see "Do Mega-Mergers..." (1984)):

> "Much of the recent credit growth was associated with the merger phenomenon." He says that merger activity explains why first-quarter business loans at large commercial banks showed an increase of $4.6 billion rather than a decline, as they generally do at this stage of the business cycle.

IS THE GROWTH OF BUSINESS LOANS IN THE CURRENT EXPANSION ANY DIFFERENT THAN IN PAST EXPANSIONS?

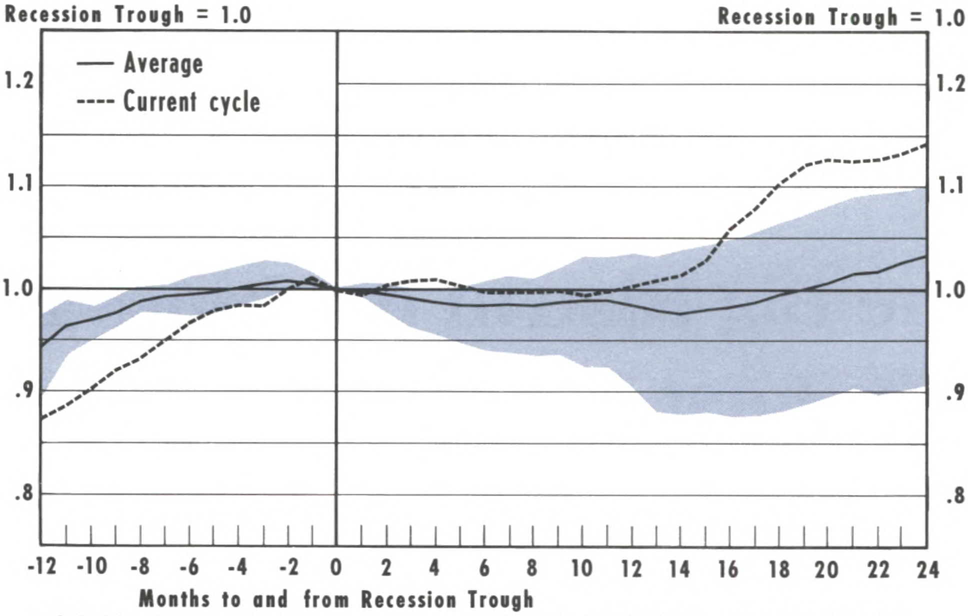
The first step in analyzing the relationship between the pace of economic activity and the growth of business loans is to examine the pattern of business loans in the current expansion relative to the patterns in previous expansions. If the pattern of business loans in the current recovery is typical of the pattern in prior expansions, alternative explanations such as bank financing of mergers and buyouts are unnecessary.

Business loans by large (weekly reporting) banks tend to stay at about the same level as at the recession trough during the first year of a recovery period, with this sluggish loan behavior giving way to moderate growth in the second year (chart 1). Thus, for the first year of the economic expansion following the 1981–82 recession, the pattern of growth in business loans by large commercial banks was similar to the pattern of business expansions since 1960.

The growth of business loans at large banks in the first half of 1984, however, was unusually rapid for that stage of an economic expansion. By the spring of 1984, the level of business loans, relative to their level at the trough of the preceding recession, was substantially above the average profile during previous expansion

Chart 1

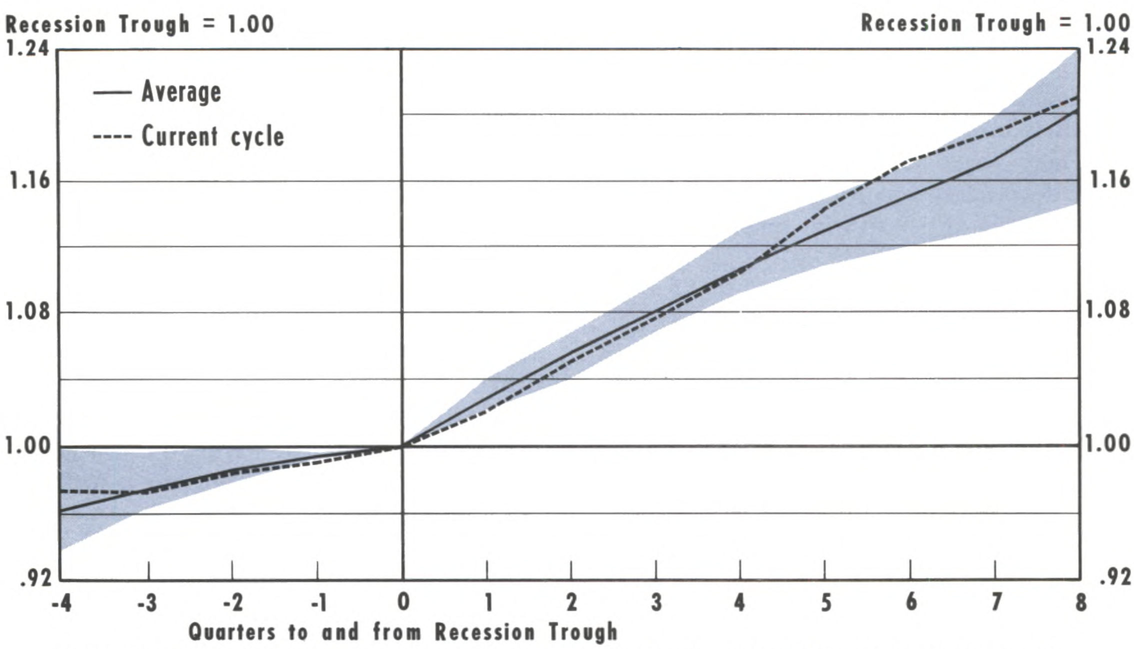
Business Loans at Large Commercial Banks Relative to Levels at Recession Troughs



NOTE: The shaded area represents the range of values observed in business cycles with recession troughs in 1960 through 1975. The profile for the cycle around the 1980 trough was excluded because its succeeding recovery did not last two years. The line labeled "average" is the average for these prior reference cycles.

Chart 2

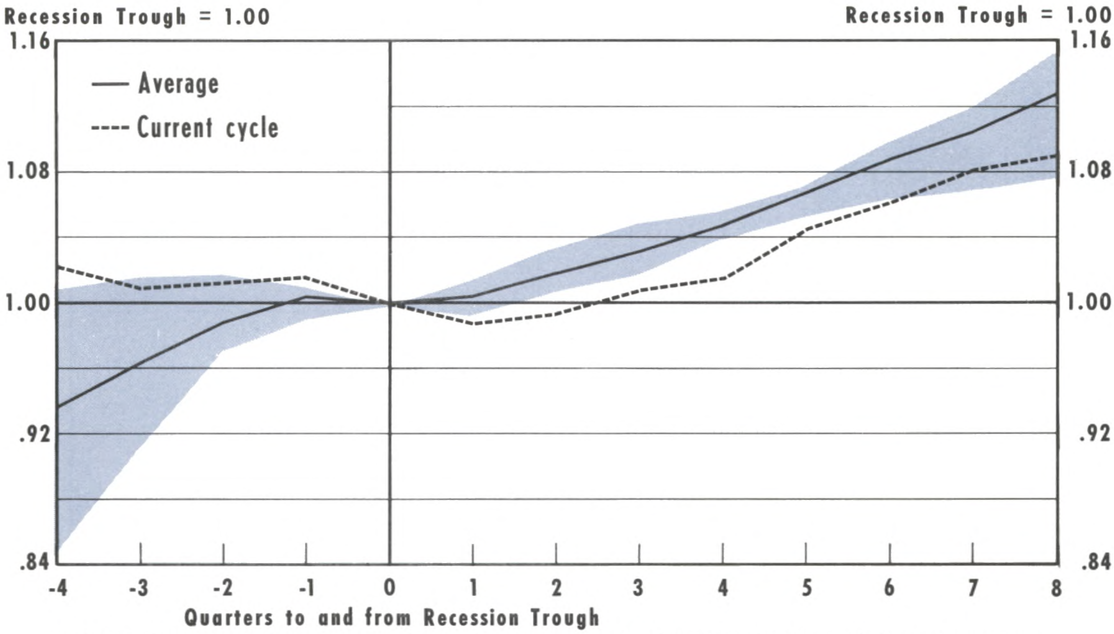
Cycles in Nominal GNP



NOTE: The shaded area represents the range of values observed in business cycles with recession troughs in 1960 through 1975. The profile for the cycle around the 1980 trough was excluded because its succeeding recovery did not last two years. The line labeled "average" is the average for these prior reference cycles.

Chart 3

Cycles in Nonfarm Business Inventories



NOTE: The shaded area represents the range of values observed in business cycles with recession troughs in 1960 through 1975. The profile for the cycle around the 1980 trough was excluded because its succeeding recovery did not last two years. The line labeled "average" is the average for these prior reference cycles.

periods. Following their rapid run-up during the first half of 1984, the growth rate of business loans at large banks has been close to the average growth rate during comparable periods of expansion. This can be seen by the parallel movement of business loans since the first half of 1984 and that of the cycle average. Consequently, the only aspect of the growth in business loans by large commercial banks that distinguishes the current expansion is the rapid growth in the first half of 1984.

PERHAPS ECONOMIC GROWTH WAS UNUSUALLY RAPID LAST YEAR

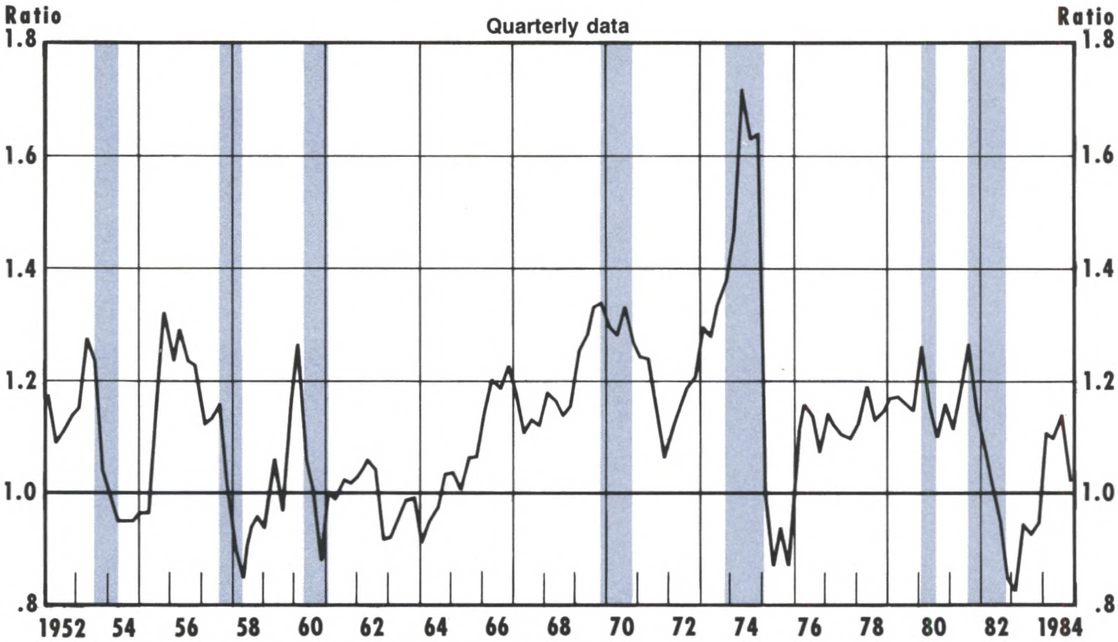
This unusually rapid rise in business loans in the first half of 1984 might reflect simply an unusually rapid rise in the pace of economic activity. This possibility is investigated in chart 2, which presents nominal GNP for several quarters before and after recession troughs in ratio to nominal GNP in trough quarters. If the pace of economic activity had become unusually rapid by the first half of 1984, the ratio in chart 2 for the current expansion would be substantially above the range for previous expansion periods. Yet, while the chart shows that nominal GNP did rise to the top of the range for previous reference cycles during the first half of 1984, it did not rise substantially *above* the range of experience in prior expansion periods.

An important link between the pace of economic activity and the growth of business loans involves the growth of business inventories. Business inventories tend to rise with the pace of economic activity during expansion periods, and businesses commonly finance their inventory investment through bank loans.[3] Thus, the unusually rapid growth of business loans last year might reflect an unusually rapid growth of business inventories. Chart 3, however, indicates that the growth of business inventories has not been unusually rapid in the current expansion. In fact, inventory expansion has been slower in this recovery than in any recovery of the past 25 years.

[3]See Hicks (1980).

Chart 4

Ratio of Fixed Plus Inventory Investment to Internal Funds



Source: Board of Governors of the Federal Reserve System
NOTE: Data are for the nonfinancial corporate sector.
Shaded areas represent periods of business recessions.

Chart 4 provides an additional perspective on the rise in the demand for credit by businesses in the current and previous expansions. This chart plots the ratio of the fixed and inventory investment of nonfinancial business corporations to their internally generated funds. Nonfinancial corporations require external financing of their fixed and inventory investment whenever this ratio is above unity, but internally generated funds substitute for external financing whenever this ratio is below unity.

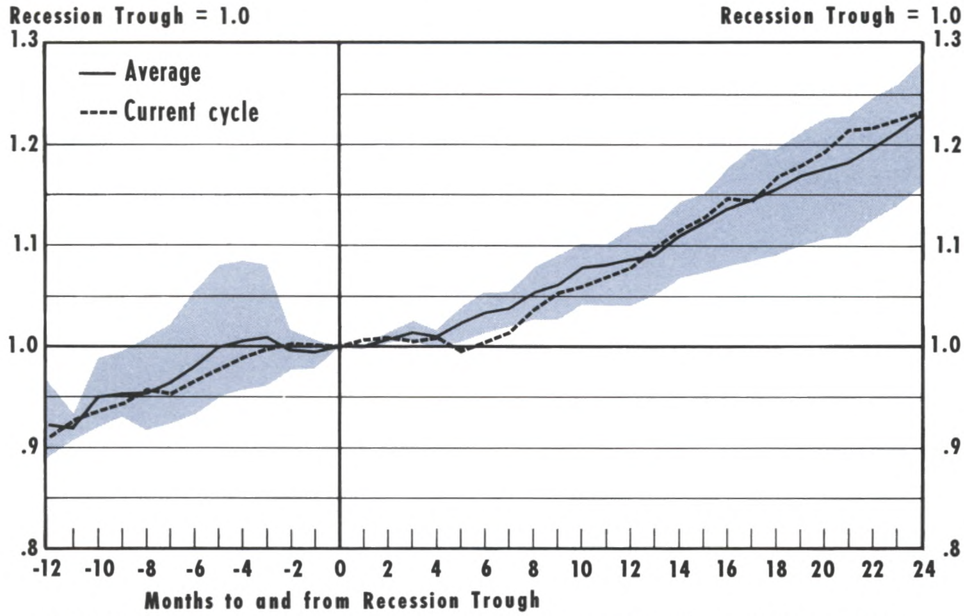
As illustrated in chart 4, internally generated funds tend to rise more rapidly than business investment during the early stages of economic expansions, so that the ratio is below unity. After a few quarters of expansion, business investment begins to exceed internal funds, and businesses then must turn to external financing. The relationship between internally generated funds and business investment is one of the reasons for the typical lag in the growth of business loans after the beginning of economic expansions illustrated in chart 1. Chart 4 clearly indicates that the relationship between business investment and internal funds in the current expansion is typical of prior expansions. Thus, chart 4 provides no explanation for the unusual rise in business loans in the first half of 1984.

Finally, consider the contrast between the pattern of business loans at large and small commercial banks in the current recovery. If business loans at large banks reflect the influence of the pace of economic activity on business credit demand, these effects would tend to be similar for both large and small banks. Chart 5 indicates, however, that the pattern of business loans at *small* banks in the current expansion is very similar to the patterns in previous expansions.[4] Thus, the influences that contributed to the unusually rapid growth of business loans at large commercial banks in the first half of 1984 did not have similar effects in boosting the growth of business loans at small banks.

[4]The series on business loans of small commercial banks was calculated by subtracting business loans of weekly reporting banks from a series on business loans of all commercial banks.

Chart 5

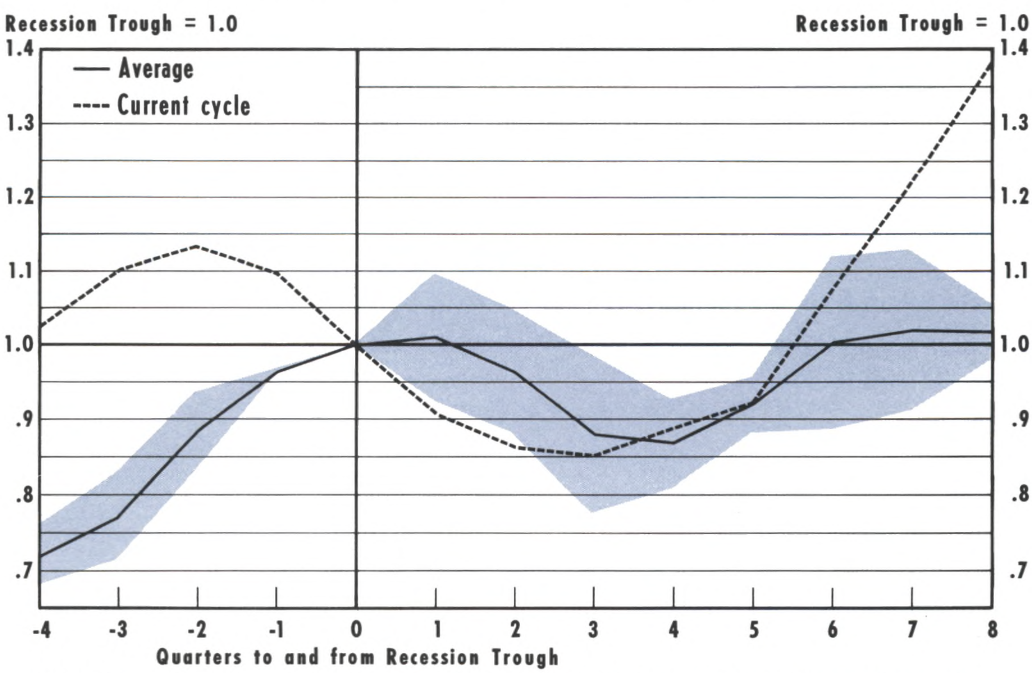
Business Loans at Small Commercial Banks Relative to Levels at Recession Troughs



NOTE: The shaded area represents the range of values observed in business cycles with recession troughs in 1960 through 1975. The profile for the cycle around the 1980 trough was excluded because its succeeding recovery did not last two years. The line labeled "average" is the average for these prior reference cycles.

Chart 6

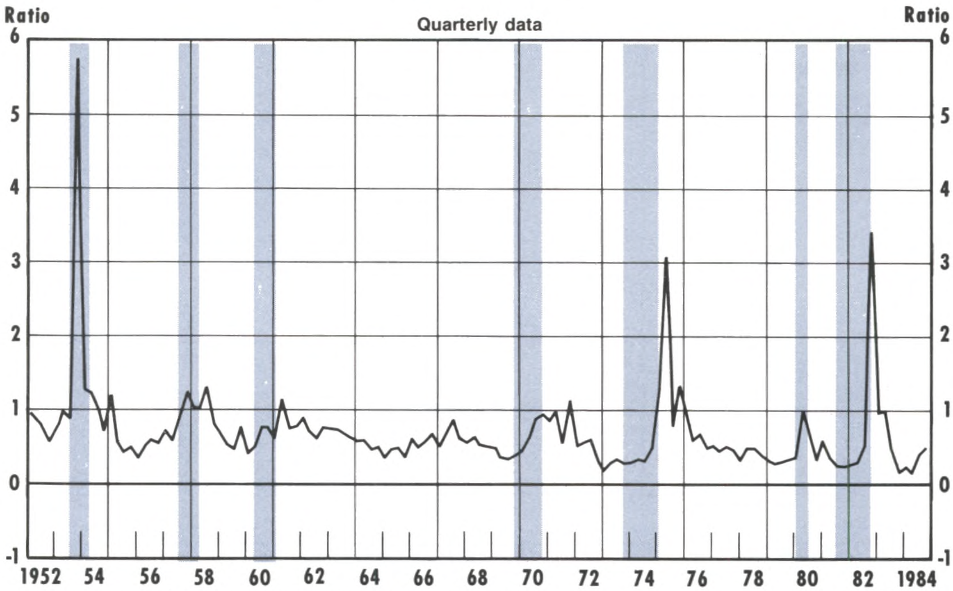
Cycles in Nonfinancial Commercial Paper



NOTE: The shaded area represents the range of values observed in business cycles with recession troughs in 1960 through 1975. The profile for the cycle around the 1980 trough was excluded because its succeeding recovery did not last two years. The line labeled "average" is the average for these prior reference cycles.

Chart 7

Ratio of Funds Raised by Long-Term Borrowing to Total Funds Raised by Borrowing [1]



Source: Board of Governors of the Federal Reserve System

[1] The ratio of funds raised by issuing bonds and mortgages to total funds raised in the financial markets, net of new equity issues.

NOTE: Data are for the nonfinancial corporate sector.

Shaded areas represent periods of business recessions.

PERHAPS THERE WAS A SHIFT IN THE COMPOSITION OF EXTERNAL FINANCING BY BUSINESS FIRMS

The previous section indicates that the rapid rise in business loans at large banks last year did not reflect an unusually rapid rise in the demand for external financing by business firms. The unusual pattern of business loans at large banks, therefore, must reflect an unusual change in the *composition* of external financing by business firms. This section considers various possible changes in the composition of business finance that might account for the rise in business loans at large banks.

A Shift to Bank Loans from Other Forms of Short-Term Credit

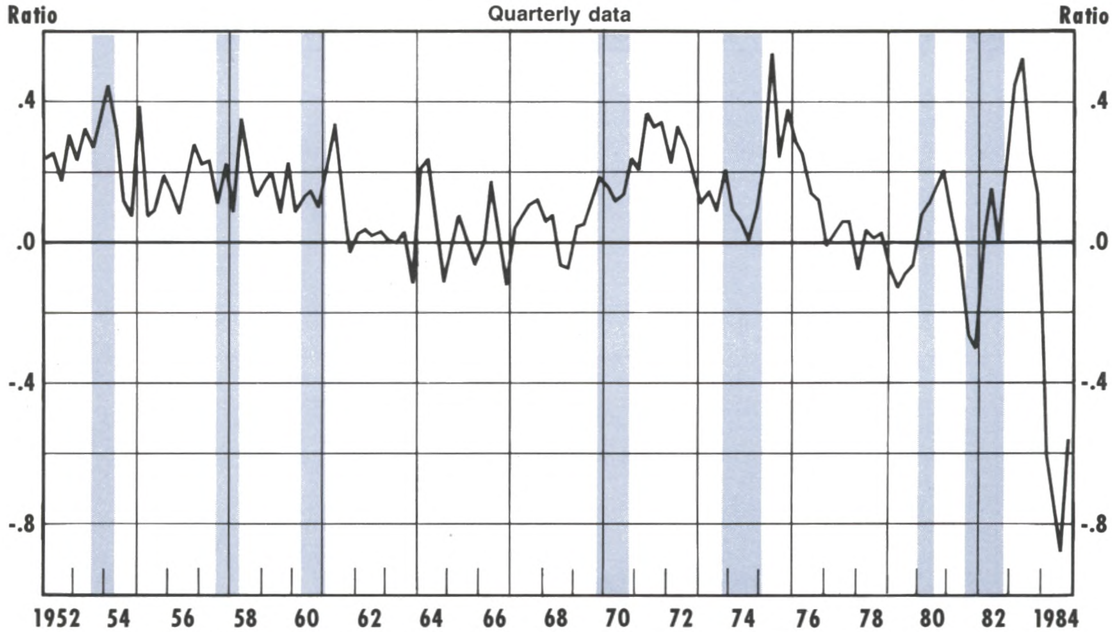
One possible shift may have involved an unusually large reduction in short-term borrowing by businesses from sources other than commercial banks. This possibility is investigated by examining the patterns of commercial paper outstanding issued by nonfinancial firms in the current and previous economic expansions. Chart 6 indicates that, rather than declining in the first half of 1984, the growth of nonfinancial commercial paper during that period was relatively rapid. Thus, the unusually rapid growth of business loans at large banks in 1984 does not reflect a shift of business credit from this type of short-term credit to loans at large banks.

A Shift from Long-Term to Short-Term Debt

Another possibility is that nonfinancial business corporations reduced their issuance of long-term debt to an unusually large degree in the first half of 1984, substituting short-term for long-term debt as a source of funds. Chart 7 presents the ratio of funds raised by nonfinancial firms by issuing bonds and mortgages to total funds raised through borrowing. This ratio has fallen during the current economic expansion, but its decline is similar to the declines in past expansion periods. Consequently, the unusually rapid growth of business loans at large banks does not appear to be the result of an unusual change in the composition of short-term and long-term debt as sources of funds for nonfinancial business corporations.

Chart 8

Ratio of Net New Equity Issues to Net Funds Raised



Source: Board of Governors of the Federal Reserve System
NOTE: Data are for the nonfinancial corporate sector.
Shaded areas represent periods of business recessions.

Reductions in Corporate Equity Accounts Financed Through Short-Term Borrowing

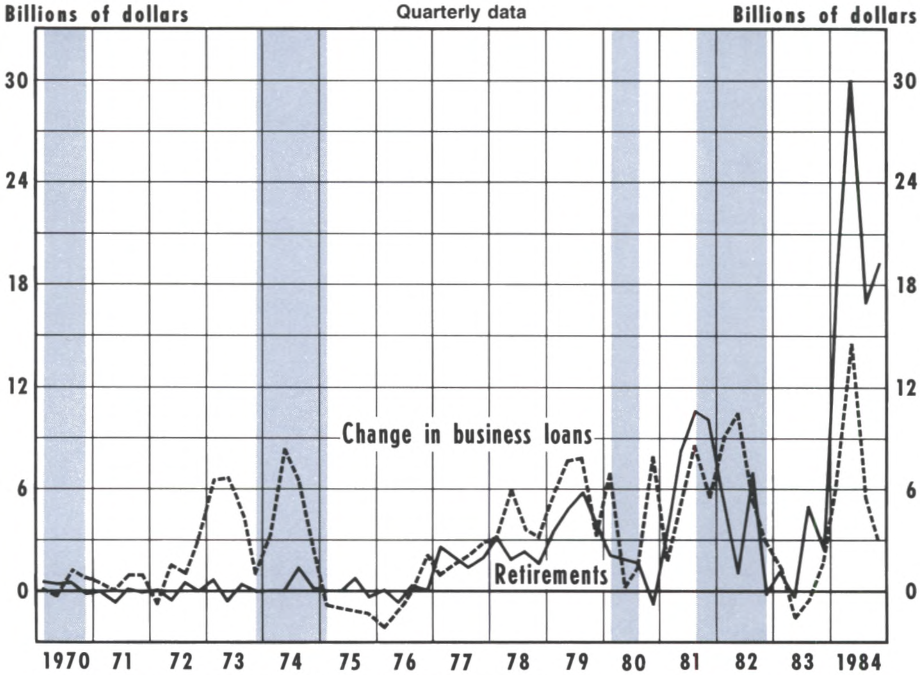
One feature of business finance that does stand out as unusual in the current expansion is the large negative values for the net funds raised by nonfinancial firms through equity issues (chart 8). A negative value implies that the transactions that *reduced* the equity capital accounts on the balance sheets of some publicly held corporations were larger than the funds *raised* by other such corporations through new equity issues. The net reductions in equity of the nonfinancial corporate sector as a result of financial transactions in each of the first three quarters of 1984 were the largest quarterly reductions ever in the flow of funds data series. (These quarterly data are available from 1952.) The contemporaneous, rapid rise in business loans at large banks suggests that nonfinancial corporations financed at least part of the transactions involved in reducing their equity accounts through loans from large banks.

Types of financial transactions that reduce corporate equity — One type of transaction that contributes to a negative value for funds raised through net corporate equity issues involves a business buying back shares of its own common stock. Another is corporate equity reductions due to mergers in which the shareholders who sell their shares receive cash.[5] There were some large mergers involving cash payment in 1984. In recent years, leveraged buyouts (LBOs) also have reduced corporate equity capital accounts. In an LBO, an investor or group of investors borrows funds, often from commercial banks, to buy the shares of publicly traded companies and convert them to privately held companies. Total publicly held corporate equity is reduced by the value of the corporation's equity when it is taken private. A list of large LBOs (each of value over $10 million) tabulated by an industry source indicates that investors borrowed $13.5 billion to finance LBOs

[5]For a cash purchase of its own stock, the corporation's assets and equity decline by the same amount. In the case of a purchase of its own stock financed by borrowings, the debt liability rises by the same amount as equity declines. When a merger is effected by one corporation buying another with cash, the equity of the surviving corporation will be the same as before the merger. Thus, aggregate corporate equity is reduced by mergers effected through cash payments to shareholders of the corporations being purchased.

Chart 9

Stock Retirements and the Change in Business Loans at Large Commercial Banks



Shaded areas represent periods of business recessions.

in 1984, up from $3.2 billion in 1982 and $2.8 billion in 1983.

The negative values for net funds raised through issuing equities reflect transactions that reduce publicly held corporate equity. The magnitude of these transactions can be measured by developing a series of stock retirements. Retirements are reductions in corporate equity claims held by the public as a result of (1) repurchases of their own shares by corporations, (2) mergers transacted as cash purchases and (3) LBOs. Retirements are computed as the difference between the total funds raised by corporations through the sale of new shares minus the net funds raised through equity issues.[6] The net funds raised reflect the retirements of equity as a deduction. As shown in chart 9, equity retirements by nonfinancial corporations rose substantially in 1984 relative to the past.

Magnitudes of Equity Retirements and Changes in Short-Term Debt — The timing of the equity retirements shown in chart 9, as well as their cumulative magnitude, matches up with the anomalous behavior of business loans by large banks shown in chart 1. The magnitude of the run-up in these loans during the first three quarters of 1984 — over $26.5 billion — is about 40 percent of the total value of equity retirements in this period, $65.7 billion. Indeed, the largest quarter of equity retirements was the second quarter, $30.2 billion, which was also the largest loan deviation from the past pattern — a rise of $14.5 billion in business loans compared with the average of $2.5 billion during previous expansions.[7]

[6]The series on stock retirements should be considered an approximation, rather than a census of retirements at all firms. The retirements series is negative in some quarters because of differences in the transactions covered in the series on total funds raised by nonfinancial corporations through the sale of new shares and in the series on net funds raised through equity issues. The series on net funds raised includes estimates of dividend reinvestments and conversions of debt to equity, which are not reflected in the series on funds raised through new equity issues. The series on retirements has a downward bias because of these differences in its components.

[7]Financing stock retirements is only one reason why businesses borrow from commercial banks. Chart 9 indicates that, from 1970 through about 1976, there was no relationship between the patterns of stock retirements and changes in business loans. The major reason for the pattern of changes in business loans during that period appears to be inventory investment financed through bank loans. Businesses increased their inventories substantially in 1973 and 1974, then gradually reduced them during 1975 and 1976. For an analysis of the determinants of business loan demand during that period, see Gilbert (1976).

CONCLUSIONS

Business loans of large commercial banks followed the usual cyclical pattern during the first year of the current economic expansion. They remained at about the same level as at the trough of the prior recession. During the first half of 1984, however, business loans of large commercial banks rose at rates exceeding those of comparable periods of previous economic expansions, before resuming normal growth in the second half of 1984.

The unusually rapid rise in business loans at large commercial banks in the first half of last year does not reflect an unusual rise in business demand for external financing. The rise in the pace of economic activity and the requirements of business firms for external financing in the current expansion have been similar to patterns in previous expansions. The most important factor that accounts for the unusually rapid growth of business loans in the first half of 1984 is the increase in corporate mergers and leveraged buyouts financed with loans from large banks. Thus, our analysis of the pattern of business loans in the current economic expansion indicates that the growth rate of business loans can be an unreliable indicator of the pace of economic activity, since it can be influenced substantially by changes in the composition of external financing by business firms.

REFERENCES

Berry, John M. "Money Supply Figures on Target," *Washington Post,* July 13, 1984.

"Do Mega-Mergers Drive Up Interest Rates?" *Business Week* (April 16, 1984), pp. 176–80.

Gilbert, R. Alton. "Bank Financing of the Recovery," this *Review* (July 1976), pp. 2–9.

Giordano, Robert M. "Financial Market Perspectives: Look Before Your Leap," *Economic Research,* Goldman Sachs Financial Market Research (July 1984).

Heinemann, Sally. "Fixed Income Markets Still Stabilizing," *New York Journal of Commerce* (June 18, 1984).

Hicks, Sydney Smith. "Commercial Banks and Business Loan Behavior," *Journal of Banking and Finance* (June 1980), pp. 125–41.

Jasinowski, Jerry J. "Less Stockpiling, More Stability," *New York Times,* June 17, 1984.

Weiner, Lisabeth. "Banks Lag Behind as Business Borrowing Booms," *American Banker* (August 22, 1984).

Money Demand Dynamics: Some New Evidence

Daniel L. Thornton

CONSIDERABLE empirical work and a significant, but considerably smaller, volume of theoretical effort has been devoted to the question of the short-run, dynamic adjustment of the demand for money. Much of the impetus for the empirical work came from the classic study by Chow (1966), who employed the partial adjustment model to characterize the adjustment of actual to desired real money balances.

Although there was early concern over the economics of Chow's specification and its relatively slow estimated speed of adjustment, this specification did not come under particularly close scrutiny until the unanticipated rise in velocity in the mid-1970s and the decline in velocity in the early 1980s.[1] As a result, a number of alternative dynamic adjustment specifications have been developed. While these specifications differ in several fundamental respects, they fall into two general categories: those that assume the price level adjusts to exogenous changes in the money stock and those that assume the nominal money stock adjusts to exogenous changes in the price level. Consequently, three fundamentally different, short-run dynamic adjustment processes have been considered in the literature: the real adjustment specification of Chow and the alternative nominal money and price adjustment specifications.[2] These specifications have received considerable attention in the literature, with much of the empirical work devoted to determining which of these specifications is most consistent with the data, for example, Goldfeld (1976), Hafer and Hein (1980), Judd and Scadding (1982a), Coats (1983), Milbourne (1983), Hetzel (1984) and Motley (1984).

The purpose of this paper is threefold. First, we review the literature on these specifications and point out that none of them can be thought of as representing adequately the short-run adjustment of actual to desired money when applied to aggregate data. Second, we demonstrate that none of these three specifications are directly comparable statistically.[3] Consequently, the relative performance of these alternatives can be assessed only by their conformity with

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[1]See, for example, Goldfeld (1976), Carr and Darby (1981), Coats (1982), Laidler (1980, 1982, 1983), Chant (1976), Judd and Scadding (1982a, 1982b), Hetzel (1984) and Motley (1984).

[2]Nearly all of the specifications that have been suggested in the literature fall into one of these basic categories, at least to the extent that they have the price level, nominal money or real money as the dependent variables. Furthermore, many of the specific alternatives are concerned with how the demand for real money balances adjusts to changes in its arguments and, as such, are consistent with any of the three fundamental adjustment processes considered here.

[3]It has been recognized, especially recently, that these alternatives are nonnested, i.e., none can be obtained by placing restrictions on any of the others. Consequently, most studies compare the forecasts of real money [e.g., Hafer and Hein (1980) and Goldfeld (1976)], or the residual sum of squares [e.g., Judd and Scadding (1982a) and Coats] of alternative models. To date, only Motley (1984) has recognized that the nominal and price specifications are not comparable.

theory and their stability. Finally, we investigate the performance of each specification using the same data and the same estimation period, II/1951–II/1984. The evidence suggests that none of these specifications have performed well over the entire period and none have been stable.

The issue of temporal stability is particularly important if one is to rely on short-run money demand in formulating short-run stabilization policy. If the short-run demand for money is unstable, then attempts to stabilize output and prices in the short run through monetary control will be unsuccessful because different levels of output and prices will be consistent with a given stock of money at different points in time. This type of short-run instability, however, does not rule out the usefulness of monetary control for achieving economic stabilization over the longer run.

DYNAMIC SPECIFICATIONS OF MONEY DEMAND

All short-run money demand specifications are based on the long-run demand for money,

(1) $m^d = f(X, \alpha, u_t) = f(Z_t)$,

where m denotes real money balances, X is a set of endogenous and exogenous variables which usually includes some measure of real income or wealth and one or more interest rates, and α is a vector of unknown parameters. The error term is denoted by u. All variables are in natural logs.

Chow based his short-run specification on the simple and convenient partial adjustment mechanism,

(2) $m_t - m_{t-1} = \lambda(m^d - m_{t-1}), \qquad 0 < \lambda \leq 1.$

He specified his adjustment process on the basis of individual economic behavior, arguing that individuals might adjust their actual stock of *real* money balances to the desired level in much the same way as they might adjust their actual stock of consumer durables to their desired level. This specification has been rationalized in a microeconomic framework in which the speed of adjustment (λ) is determined by the cost of being out of equilibrium relative to the cost of moving to equilibrium [for example, Motley (1967) and Feige (1967)].

The peculiarity of this process was quickly pointed out by Walters (1967). He noted that, in the aggregate, market equilibrium requires that the demand for real money balances equals the supply of real money. If the nominal money stock is exogenous, equilibrium requires

(3) $M/P^* = m^d$,

where M and P* denote the nominal money stock and the long-run equilibrium price level, respectively. If M is fixed in the aggregate and the price level is adjusting to changes in M, equation 2 can be thought of as the price adjustment equation:

(4) $P_t - P_{t-1} = \lambda(P_t^* - P_{t-1})$.[5]

The combination of equations 3 and 4 results in a specification that reflects Walters' criticism of the Chow model and explicitly represents the so-called price adjustment specification considered by Gordon (1984), Laidler (1983), and Hetzel.

Goldfeld (1973, 1976), on the other hand, argued against Chow's specification on microeconomic grounds. He contended that it is defective because it implies that an individual adjusts real money balances fully and instantaneously to price level changes, but only partially to money demand changes.[6] As an alternative, he offered the nominal adjustment specification,

(5) $M_t - M_{t-1} = \lambda(M_t^d - M_{t-1}) \qquad 0 < \lambda \leq 1,$

where M^d denotes the desired level of nominal money. He argued that equation 5 makes more sense than

[4]One could compare the ability of each model to forecast its dependent variable by, say, comparing percentage forecast errors (e.g., Hetzel). Such an exercise, while interesting, has little to say about the demand for money. Moreover, no objective comparison can be made, because there is no agreement about which variable is most important.

[5]Substituting equation 3 into equation 2 and holding M fixed so $M_t = M_{t-1} = M$, the resulting expression is equation 4.

The reader should note that, while we have not changed notation, the interpretation of λ in equation 4 is fundamentally different from that of equation 2. The same is true of the interpretation of λ in equation 5 below.

[6]This is most easily understood by noting that combining equation 2 with equation 1 implies not only that the long-run demand for nominal money is unit elastic with respect to price, but that the short-run nominal demand is as well.

This aspect of the real adjustment specification is not odd if one believes that money and bonds are close substitutes for each other, i.e., if a strict Keynesian liquidity preference holds. If money and fixed-dollar-denominated financial assets are held in some desired proportion given the interest rate, an unanticipated change in the *price level* will affect both money and financial assets proportionally so that an individual's relative holdings of financial assets and money will be unaffected. This will hold in either a pure asset model or in inventory theoretic transactions models. Thus, it is not unreasonable to assume that an individual's demand for real money holdings adjusts instantaneously (or at least very quickly) to unanticipated price level changes if one believes that the only link between the real and financial sectors is the interest rate.

equation 2, *a priori*, because the adjustment of nominal money to a price level change is partial rather than instantaneous as equation 2 implies.[7]

Gordon also argues for the nominal adjustment specification on microeconomic grounds.[8] He maintains that there are no adjustment costs associated with price-induced changes in real money holdings and, consequently, the only costs involved in adjusting one's portfolio are those associated with adjusting nominal money balances.[9]

Laidler (1983) notes, however, that when equation 5 is applied to aggregate data, one commits the fallacy of composition if the aggregate nominal money stock is exogenous. Individuals are free to adjust their nominal balances, but society as a whole is not. Moreover, Hetzel observes that applying equation 5 to aggregate data is tantamount to assuming that the price level is exogenous to an endogenous nominal money stock. According to this interpretation, the monetary authority supplies the nominal money balances desired by the public with a lag. In this context, the nominal adjustment model is viewed as an equation representing the market equilibrium, where λ is the adjustment parameter in the so-called Federal Reserve reaction function rather than the speed of adjustment of money demand. Given this interpretation, market equilibrium requires

$$(6)\quad M^d/P = m^d,$$

where M^d denotes the aggregate level of nominal money balances desired by the public given the price level, P.

The Short-Run Specifications

The above equations can be used to obtain the three short-run money demand specifications. Equations 1 and 2 can be combined directly to obtain

$$(7)\quad m_t = \lambda f(Z_t) + (1-\lambda)(m_{t-1}),$$

the real adjustment specification of Chow (1966).

Likewise, we can combine equations 3 with 4, and 5 with 6, to obtain what Laidler (1983) has termed quasi-reduced-form equations:

$$(8)\quad m_t = \lambda f(Z_t) + (1-\lambda)(M_{t-1} - P_t)$$

and

$$(9)\quad m_t = \lambda f(Z_t) + (1-\lambda)(M_t - P_{t-1}).$$

Because, ostensibly, all of these equations have real money on the left-hand side, it appears that these models can be compared using statistical techniques. This is incorrect.

Note that the equations 8 and 9 could just as well be specified and estimated as

$$(8')\quad M_t = \lambda f(Z_t) + (1-\lambda)M_{t-1} + \lambda P_t$$

and

$$(9')\quad P_t = -\lambda f(Z_t) + (1-\lambda)P_{t-1} + \lambda M_t.$$

Comparing equations 7, 8′ and 9′ reveals that they all have different dependent variables. Furthermore, no trivial transformation exists that will make these equations comparable; that is, regression equations cannot be manipulated algebraically to change the left-hand-side variable to anything one pleases. Therefore, nothing can be said about which specification is preferred based on comparisons of these specifications, despite claims to the contrary. (See the appendix for a more detailed discussion.)

Alternatively, one can note that equations 8′ and 9′ make different assumptions about which variable is exogenous (i.e., prices and nominal money, respectively). Since, at best, only one of these assumptions is correct, consistent estimates of the errors can be obtained from only one of these equations. Hence, any comparison based on the residuals of these two specifications is inappropriate. Furthermore, theory alone cannot serve as a guide because, at the microeconomic level, the assumption of exogenous prices seems most relevant, while in the aggregate the exogeneity of nominal money is most plausible.

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[7]By the same reasoning, one could argue that the nominal adjustment specification implies that individuals never fully adjust to expected inflation — see Carr and Darby. Both of these characterizations may be off the mark, however. A more reasonable model might allow both price level and nominal money shocks to affect the demand for money in the short run, but require them to average out to zero in the long run. This has been suggested recently by Gordon. For example, let $(M_t^d - P_t^*) = f(Z_t)$ and combine this equation with equations 4 and 5. The result is an equation that can be estimated given a further normalization rule: the residual sum of squares can be minimized in the direction of M_t or P_t. Unfortunately, the results are extremely sensitive to the normalization rule. In general, if one normalizes in the direction of M_t, the results are similar to (and often not statistically distinguishable from) those of the nominal specification. If one normalizes in the direction of P_t, the results are similar to the price adjustment specification. These results are available upon request.

[8]It is not clear exactly how Gordon means this. Certainly, individuals are free only to adjust their nominal money holdings since price must be taken as given; however, Gordon cites the energy price shock as his only example. He argues that the supply shock reduces real income and, hence, the demand for real money (presumably proportionally) so that no portfolio disequilibrium occurs.

[9]Using the standard quadratic adjustment cost approach, it can be shown that the nominal specification results if adjustment costs are associated only with nominal money *and* if prices are given. See Hwang (1984).

EMPIRICAL RESULTS

Because these alteratives are not statistically comparable, each should be evaluated for its consistency with the theory and its stability.[10] Estimates of the real, nominal and price adjustment specifications are presented in this section. The estimates reported here cover the period II/1952–II/1984, which has been divided into three subperiods: II/1951–IV/1961, I/1962–IV/1973 and I/1974–II/1984. This division is somewhat arbitrary; nevertheless, it has several aspects which make it desirable. First, the two earlier subperiods correspond closely to periods for which Goldfeld (1973) found the basic Chow equation to be stable. Hence, it will be interesting to compare the estimates of the nominal and price adjustment specifications over these periods. Second, IV/1973 marks an observed break in the nominal and real adjustment specifications.[11] Third, all three periods differ rather significantly with respect to the growth and variability of both money and prices.[12] Finally, during the first two periods, the Federal Reserve was relying almost exclusively on an interest rate target, while, in the third period, more consideration was given to monetary aggregate targets. Hence, we might expect to see some deterioration in the performance of the nominal specification over the third period.

The real (R), nominal (N) and price (P) adjustment equations are estimated with ordinary least squares (OLS) to facilitate comparisons across time periods. Durbin's h-statistic is reported to illustrate how the error structure has varied among specifications and through time.[13] Furthermore, all the equations were estimated with real money balances on the left-hand side, so that the signs of the coefficients are the same for all specifications.[14] Also, since the nominal and price specifications represent over-identified, reduced-form equations, the reported F-statistic is for a test of the over-identifying restrictions; the results reported are for equations with the restriction imposed.[15] Finally, the equations were estimated using real income (y), the commercial paper rate (CPR) and the passbook savings rate (PBR) as independent variables. This specification of long-run money demand represents a fairly standard version, following Goldfeld (1973). The equations are estimated with and without the PBR because numerous studies have found that similar variables have not been statistically significant over later periods, for example, Hafer and Hein (1980), Milbourne and Judd and Scadding (1982a).

The Three Adjustment Equations

Estimates of the three adjustment specifications for the three periods appear in table 1. Neither the real nor the nominal specifications performs well in the early period unless the PBR is included. Real income is insignificant in both equations and the over-identifying restriction is rejected at a very low significance level in the nominal specification when the savings rate is excluded.[16] Furthermore, both the real and nominal specifications produce similar estimates of the coefficients over this period. The only striking difference is the apparent first-order serial correlation in the nominal specification, not present in the real equation.

Both the real and nominal specifications perform well in the last two periods in that all the parameters (save the constants) are significant and have the anticipated sign if the PBR is excluded. Including the PBR for the I/1962–IV/1973 period, however, tends to increase the estimated coefficient on real income markedly, while it reduces it in the I/1974–II/1984 period. Indeed, real income is insignificant in the real specification in the last period if the PBR is included.

In contrast with the real and nominal specifications, real income is not significant in the price adjustment specification in the first period. Furthermore, it is sig-

[10]"Consistency with the theory" means that the coefficients should be statistically significant, correctly signed, and the adjustment coefficient should obey its restriction. Thus, these equations are interpreted (as they have been in the literature) as money demand equations. It should be noted, however, that since equations 8′ and 9′ are really quasi-reduced forms, neither is a particularly likely equation for explaining the nominal money stock or price level, respectively. I am indebted to Tom Fomby for this observation. He noticed that equation 9′ did not capture the monetarist notion of a long lag from money to prices.

[11]Hafer and Hein (1982) mark the break at IV/1973, while Lin and Oh (1984) record it at II/1974.

[12]The variances (x 100) of M and P, respectively, are (0.3449, 0.4599), (3.2210, 1.8107) and (4.6474, 4.7701) for the three periods. The simple correlations between M_t and P_t over these periods are 0.9601, 0.9947 and 0.9911.

[13]The equations also were estimated adjusting for first-order serial correlation using a maximum likelihood, grid-search procedure to estimate the coefficient of autocorrelation directly. In all instances, the qualitative conclusions were unaffected by the serial correlation correction.

[14]The adjusted R^2s are calculated for their respective dependent variable, however.

[15]The over-identifying restriction for the nominal specification 8′ is that the coefficients on M_{t-1} and P_t sum to one. The over-identifying restriction for this price specification is that the coefficients on P_{t-1} and M_t sum to one.

[16]The t-tests are one-tailed if the coefficient has an anticipated sign, two-tailed otherwise.

Table 1
Estimates of the Three Basic Adjustment Equations

Equation	Constant	y	CPR	PBR	$M_{t-1}-P_{t-1}$	$M_{t-1}-P_t$	M_t-P_{t-1}	h	$\bar{R}^2$	$SE \times 10^2$	F
II/1951–IV/1961											
R	.854*	.001	−.015*		.842*			1.52	.9418	.4828	—
	(3.72)	(0.06)	(4.62)		(22.02)						
	.674*	.129*	−.017*	−.034*	.724*			0.96	.9537	.4310	—
	(3.19)	(3.20)	(5.83)	(3.31)	(14.66)						
N	.610*	.001	−.012*			.890*		2.99*	.9943	.4434	14.29*
	(2.79)	(0.05)	(4.06)			(24.12)					
	.445*	.132*	−.015*	−.035*		.764*		2.55*	.9959	.3783	0.50
	(2.33)	(3.78)	(5.66)	(3.95)		(17.04)					
P	.444*	.000	−.004*				.917*	−0.43	.9971	.3621	0.01
	(2.44)	(0.04)	(1.77)				(29.87)				
	.424*	.034	−.005*	−.009			.880*	−0.38	.9971	.3626	2.04
	(2.31)	(0.93)	(2.00)	(0.95)			(17.87)				
I/1962–IV/1973											
R	.407	.094*	−.019*		.812*			4.26*	.9879	.5242	—
	(1.21)	(2.54)	(4.50)		(7.58)						
	.730*	.188*	−.018*	−.073*	.651*			4.16*	.9896	.4853	—
	(2.20)	(3.98)	(4.79)	(2.89)	(5.72)						
N	.051	.081*	−.014*			.894*		3.90*	.9993	.4813	5.53*
	(0.15)	(2.41)	(3.77)			(8.74)					
	.379	.159*	−.014*	−.057*		.749*		4.45*	.9993	.4591	1.20
	(1.09)	(3.42)	(4.08)	(2.32)		(6.45)					
P	.385*	.020	−.007*				.903*	0.09	.9996	.2610	4.07
	(2.84)	(1.10)	(3.25)				(19.11)				
	.491*	.060*	−.007*	−.028*			.841*	0.00	.9997	.2517	0.84
	(3.50)	(2.29)	(3.70)	(2.08)			(15.45)				
I/1974–II/1984											
R	−.069	.096*	−.023*		.894*			−0.14	.8795	1.0080	—
	(0.20)	(4.13)	(4.20)		(16.11)						
	−.060	.057	−.024*	.107	.913*			−0.50	.8809	1.0020	—
	(0.18)	(1.44)	(4.36)	(1.21)	(15.92)						
N	−.005	.051*	−.011*			.941*		−0.74	.9985	.8332	0.04
	(0.02)	(2.61)	(2.28)			(19.93)					
	−.013	.057*	−.011*	−.018		.939*		−0.75	.9985	.8437	0.37
	(0.05)	(1.71)	(2.20)	(0.24)		(19.30)					
P	−.146	.050*	−.014*				.962*	3.15*	.9995	.5055	19.61*
	(0.87)	(4.29)	(4.77)				(33.83)				
	−.133	−.001	−.015*	.139*			.988*	1.73	.9996	.4424	5.50*
	(0.91)	(0.08)	(5.84)	(3.55)			(38.11)				

Absolute value of the t-statistic in parentheses. *Significant at 5 percent level.

Table 2
Likelihood Ratio Test Results

	Tests of Equality of Parameters			
	Periods 1 and 2		Periods 2 and 3	
Specification	PBR	No PBR	PBR	No PBR
R	9.61	20.90*	22.82*	22.48*
N	5.55	13.63*	10.30	9.43
P	6.70	2.73	42.28*	12.25*

	Tests of Equality of Variances			
	Periods 1 and 2		Periods 2 and 3	
Specification	PBR	No PBR	PBR	No PBR
R	0.10	0.01	26.52*	23.77*
N	1.84	0.49	20.07*	17.67*
P	5.77*	4.67*	13.48*	11.97*

*Significant at the 5 percent level.

Critical values: $\chi^2_{.05}(1) = 3.84$,
$\chi^2_{.05}(4) = 9.49$,
$\chi^2_{.05}(5) = 11.07$.

nificant in the second period, but only if the passbook rate is included, and, in the third period, only if the PBR is excluded. In this instance, the PBR enters with the wrong sign. Finally, the over-identifying restriction cannot be rejected at the 5 percent level during the first two periods in the price specification, but is rejected for the I/1974–II/1984 period.

It is interesting to note that, although real income is not significant in the price equation in the first period (or in the second if the PBR is excluded), the standard error from this specification is lower than that of either the real or nominal specifications. If one thought that all these equations had the same dependent variable, one would conclude incorrectly that the price equation is the preferred specification.[17] Moreover, the results are inconsistent with Laidler's (1983) conjecture that these equations are so similar that, if either the real or nominal specifications performs well, then so will the price specification.[18]

Furthermore, much of the apparent instability in these specifications is associated with the scale variable, the constant term, the PBR and the standard error itself, rather than with the CPR or the adjustment coefficient.

Formal Tests of Stability

In order to test the stability of these specifications through time, likelihood ratio tests were performed on general specifications that allowed for differences in the variances of the equation and the coefficient of autocorrelation as well as the structural parameters.[19] The results of tests of the equality of the coefficients and variances are presented in table 2. The results suggest that Goldfeld's (1973) conclusion about the stability of the real specification over the first two periods is critically dependent upon the specification of the long-run demand for money. If the PBR is included, the null hypothesis that the structural parameters are stable cannot be rejected. If it is excluded, the hypothesis is rejected. Furthermore, the hypothesis of structural stability between the second and third periods is rejected for the real specification regardless of whether the PBR is included.

The price adjustment specification does not fare much better. While the null hypothesis of the equality of the structural parameters cannot be rejected for the first two periods, the insignificance of real income in either period makes the result of little interest. Moreover, the hypothesis is rejected decisively in a comparison of the last two periods.

The results for the nominal specification are more encouraging. The null hypothesis is rejected during the first period only if the PBR is excluded. More importantly, the hypothesis is not rejected at the 5 per-

[17]Hence, it is not surprising that Coats and Judd and Scadding (1982a) concluded that these specifications are preferred.

[18]In fairness to Laidler, he goes on to argue that none of these specifications is likely to be stable over time, a conjecture that our empirical results support.

[19]It is well known that the standard F-test for structural stability is sensitive to heteroscedasticity. See Toyoda (1974) and Schmidt and Sickles (1977). Thus, likelihood ratio tests were constructed to allow for heteroscedasticity. This procedure is complicated by the presence of statistically significant serial correlation across some of the partitions. This was handled by obtaining maximum likelihood estimates of the coefficient of autocorrelation over each partition. The tests were conducted with the model transformed appropriately to adjust serial correlation. If there was no statistically significant autocorrelation in a subperiod, the untransformed data were used. If there was prior evidence of serial correlation, the Prais-Winsten transformation was used. If there was no evidence of prior serial correlation, the initial observation was included unweighted [see Fomby, Hill and Johnson (1984), p. 213, and Thornton (1984)]. Maximum likelihood estimates of the restricted model were obtained using an iterative procedure. The resulting likelihood ratio statistics are asymptotically distributed $\chi^2(J)$, where J is the number of restrictions.

Table 3

Estimates for the I/1974–II/1984 Period With Dummy Variables for Credit Controls

Variable	Specification R		N		P	
Constant	−.141	−.155	−.102	−.099	−.081	−.100
	(0.52)	(0.54)	(0.46)	(0.45)	(0.59)	(0.61)
y	.047	.095*	.050*	.048*	−.003	.052*
	(1.50)	(5.02)	(1.93)	(3.17)	(0.18)	(4.58)
CPR	−.023*	−.022*	−.009*	−.009*	−.015*	−.013*
	(5.16)	(4.77)	(2.41)	(2.47)	(6.35)	(4.92)
PBR	.133		−.006		.148	
	(1.89)		(0.11)		(4.10)	
$M_{t-1} - P_{t-1}$	.933*	.910*				
	(20.18)	(19.71)				
$M_{t-1} - P_t$			.961*	.961*		
			(24.91)	(25.64)		
$M_t - P_{t-1}$					.978*	.952*
					(40.71)	(34.25)
Dummy II/1980	−.038*	−.036*	−.028*	−.028*	−.010*	−.010
	(4.66)	(4.35)	(4.27)	(4.35)	(2.50)	(1.91)
Dummy III/1980	.011	.012	.019*	.019*	−.007	−.006
	(1.37)	(1.40)	(2.79)	(2.83)	(1.78)	(1.23)
SE × 10^2	.7935	.8214	.6518	.6427	.4057	.4868
$\bar{R}^2$	.9253	.9200	.9991	.9991	.9997	.9995
h	.267	.811	.400	.414	.528	2.713*
Coefficient equality	27.44*	24.59*	10.19	9.30	48.45*	13.87*
Variance equality	12.44*	11.73*	7.04*	5.56*	8.61*	10.62*

Absolute value of the t-statistics in parentheses. *Significant at 5 percent level.

cent level during the latter period, regardless of the specification. The test statistic is borderline, however, especially when the PBR is excluded. Furthermore, there is a significant increase in the variance of the specification as well as a marked change in the serial correlation of the error structure. (These results are consistent with recent findings of Lin and Oh.) Thus, it appears that this specification has changed in some fundamental way during the last period.

The Impact of Credit Controls

All three specifications indicate a significant increase in the variance of the equation during the latter period. Hein (1982) has presented some evidence that this change may be due in part to the credit controls of 1980; more recently, Gordon and Hafer and Thornton (1985) have shown that the credit controls had a statistically significant impact on conventional money demand equations. Hence, this marked increase in the variance of both the real and nominal specifications may be due to credit controls. Given the importance of heteroscedasticity in tests of parameter stability, it is important that this possibility be accounted for. Thus, credit control dummy variables for II/1980 and III/1980 were included in all specifications. (They were included in the price specification out of curiosity, since *a priori* it is difficult to determine their effect on the price level.)

OLS estimates of these equations for the third period appear in table 3. The likelihood ratio statistics for tests of the equality of the parameters and variances over the last two periods also appear. Including the credit control dummy variables substantially lowered the estimated standard errors for the real and nominal specifications, as anticipated; however, the reduction for the price specification (not surprisingly) is not as large. Both credit control dummy variables are significant in the nominal specification, roughly equal in

Table 4

Estimates of the Nominal Specification With M1 Net of OCD

	I/1974–II/1984	I/1974–IV/1980
Constant	−.188	−.322
	(0.48)	(0.59)
y	0.27	0.26
	(0.58)	(1.18)
CPR	−.020*	−.007*
	(3.12)	(1.80)
PBR	−.002	−.042
	(0.01)	(0.34)
$M_{t-1} - P_t$	1.010	1.018
	(25.70)	(13.27)
Dummy II/1980	−.021	−.029
	(1.65)	(4.94)
Dummy III/1980	0.20	.014
	(1.65)	(2.23)
SE × 10^2	1.1691	.5194
$\bar{R}^2$	.9963	.9983
h	.159	−.333

Absolute value of the t-statistics in parentheses. *Significant at 5 percent level.

magnitude and opposite in sign. Only the first dummy variable is significant in either the real or price specifications; its coefficient in the real money specification is approximately equal to the sum of the coefficients of the nominal money and price adjustment specifications.

Despite the obvious importance of the credit controls to these specifications, especially the nominal one, the conclusions of the stability tests are not different from those reported in table 2. Consequently, the credit controls had no effect on the outcome of tests for structural stability.

Additional Evidence on the PBR

The performance of these equations is greatly affected by the presence or absence of the PBR. In particular, it bears greatly on the tests of the stability of the structural coefficients of the nominal and real specifications. The hypothesis of stability is rejected over the first two periods and is borderline over the last two periods if this variable is excluded. Furthermore, the switch of the PBR itself from statistical significance to insignificance might be considered evidence of instability. The sensitivity of these specifications to the PBR could have a sound economic basis or be a mere statistical artifact. If the latter is correct, it would appear that these specifications have been considerably less stable temporally than is generally supposed. Consequently, the role of this variable deserves additional attention.

Over most of the estimation period considered here, M1 was composed primarily of non-interest-bearing demand deposits and currency. Consequently, one could argue that the PBR constituted an important opportunity cost variable — especially over the first two periods — and that the equations are seriously misspecified if this variable is excluded. In the last period, however, the PBR might be considered a proxy for the own rate, as interest-bearing transaction accounts (paying explicit rates close to the PBR) made up a large part of M1.[20]

In order to test this explanation, M1 less other checkable deposits (OCD) was used in place of M1 in the nominal specification over the last period. This measure corresponds closely to the old currency-plus-demand-deposits definition of money. If the above conjecture is correct, this specification should perform well in the sense that both real income and the PBR should enter significantly. If the performance is poor, either there has been an underlying shift in money demand in the most recent period or money demand has never been stable.

This approach is limited by the fact that the proportion of demand deposits held by individuals declined after the nationwide introduction of NOW accounts in 1981. This could bias the results for estimates over the entire I/1974–II/1984 period. Thus, the adjusted M1 measure was estimated for the entire third period and for the subperiod I/1974–IV/1980.[21] The results, reported in table 4, show that neither the PBR nor real income enter significantly in this equation for either time period. Furthermore, the adjustment coefficient is negative, indicating an unstable dynamic specification. The results are not consistent with the conjecture that the PBR represents a critical variable in the long-run demand for money. Thus, the conclusion that none of the short-run money demand specifications have been stable is more attractive.

[20]The PBR might not be a good proxy for the own rate on NOW accounts over this period because it does not account for service charges associated with these deposits.

[21]The real and price specifications were estimated but not reported. Also, the equations using adjusted M1 were estimated over the first two periods but are not reported because they differ little from those reported in table 1.

SUMMARY AND CONCLUSIONS

This article has dealt with alternative specifications of the short-run demand for money. It has pointed out that, although three basic forms of the dynamic adjustment of money demand have been compared in the literature, they are not strictly amenable to statistical testing. The specifications were estimated for three subperiods over the period II/1951–II/1984. It was found that (1) all three specifications are very sensitive to whether the passbook savings rate is included, (2) none produce results consistent with economic theory for all three periods and (3) none exhibit temporal stability. While, strictly speaking, the hypothesis of temporal stability could not be rejected at the 5 percent level for Goldfeld's nominal money adjustment specification for the last two periods, it could be rejected at a slightly higher significance level. Furthermore, the variance of this specification and the serial correlation of the error structure changed significantly in the last period.

Moreover, the stability test results for both the nominal and real adjustment specifications over the first two periods depend critically on including the passbook savings rate in the specification of long-run money demand. Subsequent investigation produced results that raise questions about the role the passbook rate has played in money demand. If the performance of the passbook rate in the first two subperiods is merely a statistical quirk, then, contrary to common belief, neither of these specifications is stable over these periods.

The instability of these particular specifications is not too surprising when it is recognized that they represent reduced forms of the dynamic adjustment of money and prices, rather than structural money demand equations. Consequently, while these specifications are standard in the literature, their instability may say little about the instability of money demand. Thus, our results cast doubt on the usefulness of these specifications for short-run monetary control, without indicting money demand in general or usefulness of monetary control for short-run economic stabilization. In any event, the instability of these equations certainly does not preclude the usefulness of monetary growth targets in achieving longer-run economic stability.

REFERENCES

Carr, Jack, and Michael R. Darby. "The Role of Money Supply Shocks in the Short-Run Demand For Money," *Journal of Monetary Economics* (September 1981), pp. 183–99.

Chant, John F. "Dynamic Adjustments in Simple Models of the Transactions Demand for Money," *Journal of Monetary Economics* (July 1976), pp. 351–66.

Chow, Gregory C. "On the Long-Run and Short-Run Demand For Money," *Journal of Political Economy* (April 1966), pp. 111–31.

________. "A Comparison of Alternative Estimators for Simultaneous Equations," *Econometrica* (October 1964), pp. 532–53.

Coats, Warren L., Jr. "Modeling the Short-Run Demand for Money With Exogenous Supply," *Economic Inquiry* (April 1982), pp. 222–39.

Feige, Edgar L. "Expectations and Adjustments in the Monetary Sector," *American Economic Review* (May 1967), pp. 462–73.

Fomby, Thomas B., R. Carter Hill and Stanley R. Johnson. *Advanced Econometric Methods,* (Springer-Verlag, 1984).

Goldfeld, Stephen M. "The Demand for Money Revisited," *Brookings Papers on Economic Activity* (1973:3), pp. 577–638.

________. "The Case of the Missing Money," *Brookings Papers on Economic Activity* (1976:3), pp. 683–730.

Gordon, Robert J. "The Short-Run Demand for Money: A Reconsideration," *Journal of Money, Credit and Banking,* (November 1984), pp. 403–34.

Hafer, R. W., and Scott E. Hein. "The Dynamics and Estimation of Short-Run Money Demand," this *Review* (March 1980), pp. 26–35.

________. "The Shift in Money Demand: What Really Happened?" this *Review* (February 1982), pp. 11–16.

Hafer, R. W., and Daniel L. Thornton. "Price Expectations and the Demand for Money: A Comment," *Review of Economics and Statistics* (forthcoming 1985).

Hein, Scott E. "Short-Run Money Growth Volatility: Evidence of Misbehaving Money Demand?" this *Review* (June/July 1982), pp. 27–36.

Hetzel, Robert L. "Estimating Money Demand Functions," *Journal of Money, Credit and Banking* (May 1984), pp. 185–93.

Hwang, Hae-shin. "Test of the Adjustment Process and Linear Homogeneity in a Stock Adjustment Model of Money Demand," processed (1984).

Judd, John P., and John L. Scadding. "Dynamic Adjustment in the Demand for Money: Tests of Alternative Hypotheses," Federal Reserve Bank of San Francisco *Economic Review* (Fall 1982a), pp. 19–30.

________. "The Search For A Stable Money Demand Function: A Survey of the Post-1973 Literature," *Journal of Economic Literature* (September 1982b), pp. 993–1023.

Laidler, David E. W. *Monetarist Perspectives.* (Harvard University Press, 1982.)

________. "The 1981–82 Velocity Decline: A Structural Shift in Income or Money Demand?" *Monetary Targeting and Velocity,* Proceedings of a Conference held at the Federal Reserve Bank of San Francisco (December 1983), pp. 100–03.

________. "The Demand for Money in the United States — Yet Again," in Karl Brunner and Allan M. Meltzer, eds., *On the State of Macro-economics,* Carnegie-Rochester Conference Series on Public Policy (North-Holland, Spring 1980), pp. 219–71.

Lin, Kuan-Pin and John S. Oh. "Stability of the U.S. Short-Run Money Demand Function, 1959–81," *Journal of Finance* (December 1984), pp. 1383–96.

Milbourne, Ross D. "Price Expectations and the Demand for Money: Resolution of a Paradox," *Review of Economics and Statistics* (November 1983), pp. 1287–305.

Motley, Brian. "Dynamic Adjustment in Money Demand," Federal Reserve Bank of San Francisco *Economic Review* (Winter 1984), pp. 22–26.

________ . "The Demand-for-Money Function for the Household Sector — Some Preliminary Findings," *Journal of Finance* (September 1967), pp. 405–18.

Schmidt, Peter, and Robin Sickles. "Some Further Evidence on the Use of the Chow Test Under Heteroscedasticity," *Econometrica* (July 1977), pp. 1293–98.

Thornton, Daniel L. "On the Treatment of the Initial Observation in the AR(1) Regression Model," Federal Reserve Bank of St. Louis Working Paper No. 84-003 (1984).

Toyoda, Toshihisa. "Use of the Chow Test Under Heteroscedasticity," *Econometrica* (May 1974), pp. 601–08.

Walters, A. A. "The Demand For Money — The Dynamic Properties of the Multiplier," *Journal of Political Economy* (June 1967), pp. 293–98.

APPENDIX

The purpose of this appendix is to show that equations 7, 8 and 9 minimize the residual sum of squares in different directions and, because of this, the residuals from these specifications are not statistically comparable. This appendix draws heavily on the work of Chow (1964). Consider the standard regression model

$$Y = X\beta + u,$$

where Y is a T by 1 vector of the dependent variable, X is a T by k matrix of independent variables, β is a k by 1 vector of unknown parameters and u is a T by 1 vector of random errors. It is now commonly understood that the least squares estimate of the vector β is geometrically the particular linear combination of the regressor variables that minimizes the squared distance between the vector Y and the space spanned by the columns of X. It is less well known that this estimate is obtained by imposing a particular direction and scale normalization rule. To see this, consider the more general model

$$\beta_1 Y_1 + \beta_2 Y_2 = \mu_1 X_1 + \mu_2 X_2 + u,$$

where Y_1, Y_2, X_1 and X_2 are T by 1 vectors with scalar parameters β_1, β_2, μ_1 and μ_2. Chow notes that estimates of the parameters of this model could be obtained by least squares by projecting the linear combination of the Y's (that is, $\beta_1 Y_1 + \beta_2 Y_2$) on the space spanned by X_1 and X_2. In this case, least squares estimates would be obtained by projecting the vector $\beta_1 Y_1 + \beta_2 Y_2$ in the direction of $(X_1 X_2)$. This would establish the direction-normalization. Once this is accomplished, the scale can be obtained by choosing any scale-normalization (for example, β_1, β_2, μ_1 or $\mu_2 = 1$). In this case, direction-normalization and scale-normalization are separate. Chow points out, however, that if the restriction $\beta_1 = 1$ were imposed before the minimization, the vector Y_1 alone is projected on the space spanned by $(Y_2\ X_1\ X_2)$. That is, the analyst is asserting that the vector Y_1, has a mean vector in the space $(Y_2\ X_1\ X_2)$ and an additive random error orthogonal to the space spanned by $(Y_2\ X_1\ X_2)$. Alternatively, if the restriction $\beta_2 = 1$ were imposed, the least squares estimates would be obtained by projecting the vector Y_2 on the space spanned by $(Y_1\ X_1\ X_2)$. This would imply that the analyst viewed Y_2 as having a mean vector in the space $(Y_1\ X_1\ X_2)$ and an additive random error vector orthogonal to $(Y_1\ X_1\ X_2)$.

Clearly, the residual vectors obtained from these different orthogonal projections are in general different random variables and are, therefore, not comparable. The same is true of error vectors from equations 7, 8 and 9. We can establish this by noting that minimization is obtained after imposing different restrictions (normalization rules). For example, the implicit coefficient on $(M-P)_t$ is set equal to one in equation 7. Likewise, the coefficients on M_t and P_t, respectively, are set equal to one in equations 8 and 9.

The Federal Reserve Reaction Function: Does Debt Growth Influence Monetary Policy?

Richard G. Sheehan

THE prospect of federal government deficits totaling $907 billion between 1985 and 1990 has renewed doubts about the Federal Reserve's ability to conduct independent monetary policy. Often implicitly underlying these doubts is the fear that increases in federal debt will drive up interest rates and slow economic growth in the absence of expansionary monetary policy. Given the magnitude of projected federal deficits, many analysts are concerned that the Federal Reserve may feel obliged to increase the money stock faster than it otherwise would to keep interest rates from rising.[1]

It is the purpose of this paper to offer some evidence on the extent to which the Federal Reserve has altered monetary policy in response to federal deficits.[2] The focus here is to determine if monetary policy has reacted to federal deficits in a consistent manner over time. The sensitivity of monetary actions to debt growth is considered over different time periods and under alternative measures of monetary actions and debt.

MONETARY POLICY AND DEBT

The textbook view of the relationship between monetary policy and federal debt can be demonstrated in the context of a simple comparative static money market model, which is summarized in figure 1. Let us assume that money demand (MD) is a function of the interest rate and the level of income and that the Federal Reserve can effectively fix the money supply (MS). With some initial level of income, money demand and supply functions may be represented by MD_0 and MS_0, respectively. Given a structural (or exogenous or active) change in fiscal policy, say, an expansionary action increasing the deficit, income will rise in the short run.[3] This increase in income, in turn, will lead to an increase in money demand, shifting the money demand curve from MD_0 to MD_1 in figure 1 and driving up interest rates. If the Federal Reserve is operating with a monetary aggregate target, monetary policy will not respond to the deficit. The structural

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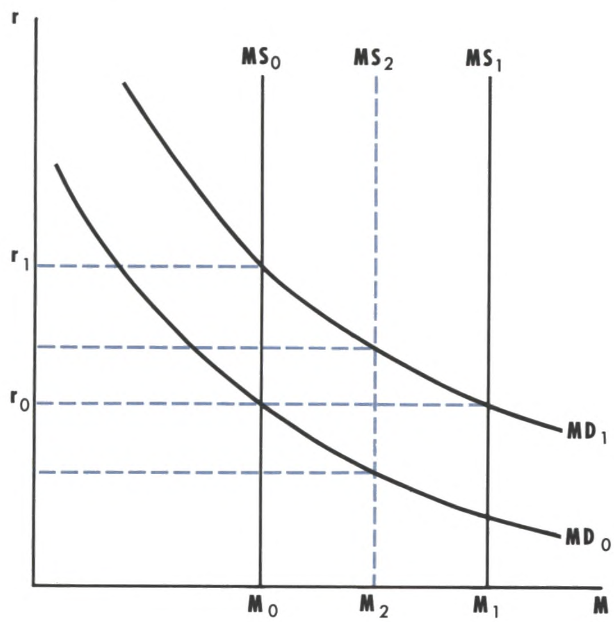
[1]Sargent and Wallace (1981) have gone so far as to argue that the Federal Reserve has only a choice between increasing the money stock sooner or later. While Darby (1984) has disputed this contention, the issue apparently remains unresolved. See Miller and Sargent (1984).

[2]The process of a debt increase directly leading to expansionary monetary policy is often labeled "monetizing the debt." Given the ambiguities surrounding that phrase, it is not used here. See Thornton (1984) for a detailed explanation of alternate definitions of the phrase.

[3]A change in fiscal policy, that is, a change in the behavior of fiscal policymakers, is considered structural, exogenous or active. Thus, a fiscal-policy-induced change in the deficit, as one measure of fiscal policy, also is considered exogenous. It is assumed that the fiscal policy change and resulting deficit change are not prompted by a change in the business cycle. A change in the deficit resulting from a change in, say, real GNP is considered cyclical, endogenous or passive. See Tatom (1984) for a more extensive discussion of the distinction between active and passive deficits.

Figure 1
Comparative Static Money Market Model



deficit will not alter the money stock but will increase the interest rate from r_0 to r_1.[4]

With cyclical (or endogenous or passive) fiscal policy changes, however, the impact of changes in the structural deficit is quite different. Assume the economy enters a recession as a result of a non-policy shock to the system. The automatic stabilizing properties of federal taxes and expenditures will lead to a cyclical increase in the deficit as income declines. Further, the decline in income will reduce the demand for money, shifting the money demand schedule, say, from MD_1 to MD_0 in figure 1. Again, if the Federal Reserve is using a monetary aggregate as its target, the money stock will remain constant. An increase in the cyclical deficit will now be accompanied, however, by a reduction in the interest rate from r_1 to r_0. With a monetary aggregate target, this model implies that structural deficits will lead to increases in the interest rate, while cyclical deficits will be accompanied by decreases in the interest rate.

In contrast, if the Federal Reserve is using the federal funds rate as its target, the increase in the structural deficit and the resulting increase in money demand will prompt it to respond differently. The increase in interest rates as money demand increases from MD_0 to MD_1 would lead the Federal Reserve to increase the money supply (from MS_0 to MS_1) sufficiently to drive interest rates in general and the federal funds rate in particular back to their original levels.[5] With an interest rate target, the exogenous deficit increase would not influence the interest rate but would increase the money stock.

If the Federal Reserve has not followed a pure interest rate or monetary aggregate target but instead has followed a mixed strategy using both, a structural deficit would still shift the money demand curve out as before, but the money supply curve would shift out only partially, say, from MS_0 to MS_2.[6] Thus, the structural debt increase would lead to both higher interest rates and higher money growth.

With a federal funds target and an increase in the cyclical deficit leading to a decrease in money demand from MD_1 to MD_0, the Federal Reserve would decrease the money stock from MS_1 to MS_0 to keep the interest rate unchanged. With a mixed targeting strategy and an increase in the cyclical deficit, the money supply would be expected to shift partially downward from MS_1 to MS_2. Thus, the increased deficit would be accompanied by a lower interest rate and a lower money supply.

Whether an increase in the deficit is accompanied by increases or decreases in the money stock and interest rates depends on the source of the deficit and on the manner in which the Federal Reserve is conducting policy. The alternatives are summarized in table 1.

It should be noted that a given deficit may combine structural and cyclical elements. In that case, the impact of the deficit on the interest rate is ambiguous if the Federal Reserve targets on a monetary aggregate; its impact on the money supply is ambiguous if the Fed targets on interest rates. Both impacts would be ambiguous with a mixed targeting procedure. Further, there is no guarantee that the Federal Reserve has followed (or will follow) a consistent pattern of target-

[4]This discussion assumes loanable funds demand is not completely elastic. It further assumes the Federal Reserve is focusing on a monetary aggregate and will not change its desired value of that aggregate in the face of temporary fluctuations in income.

[5]If the Federal Reserve is operating with an interest rate target, it is also necessary to assume that the Federal Reserve believes that money changes can alter interest rates — as they do in this simple model — and that the Fed has a willingness to alter the money stock based on that belief.

[6]Lombra and Moran (1980) cite evidence suggesting this is typical of Federal Reserve behavior.

Table 1
Expected Coefficient on Debt Term in Measures of Monetary Policy

	Structural debt increase		Cyclical debt increase		Combination debt increase	
Monetary aggregate target	M	0	M	0	M	0
	r	+	r	–	r	?
Interest rate target	M	+	M	–	M	?
	r	0	r	0	r	0
Mixed targeting procedure	M	+	M	–	M	?
	r	+	r	–	r	?

ing on either. Thus, the debt coefficient need not be stable over time.

From 1958 to 1984, the Federal Reserve intermediate policy targets apparently underwent substantial revision. For example, through the 1960s, it is generally assumed that the Federal Reserve's primary concern was controlling interest rates.[7] Monetary aggregates began to receive more attention in the early 1970s. From October 1979 to October 1982, there was an emphasis on monetary aggregate targeting; since then aggregate targeting has become more flexible with less prominence given to M1.[8] Thus, at least four regimes can be identified: (1) from 1958 to approximately 1970, characterized by interest rate targeting, (2) from the early 1970s to October 1979, a mixed targeting strategy, (3) from October 1979 to October 1982, a monetary aggregate target, and (4) from October 1982 to the present, again a mixed targeting strategy. While it would prove fruitful to examine "reaction functions" estimated separately over each of these periods, the short time frames of the latter two periods preclude that option. Thus, the sample is divided into two subperiods, the first prior to 1971 characterized by interest rate targeting and the second from 1971 with a greater focus on monetary aggregates.

THE "REACTION FUNCTION" APPROACH

There have been a number of previous studies that have examined the relationship between monetary policy and federal deficits. Most of these studies fall under the general heading of estimating a "reaction function" for the Federal Reserve.[9] The reaction function approach assumes that the Federal Reserve's policy actions are based on its goals, its model of the economy and the constraints that the model implies. Thus, the estimated reaction function is based implicitly — or explicitly in the case of McMillin and Beard (1980) — on output and financial market models, together with a rule (that is, an assumption about how the Fed will react to disturbances to reach its goals) for determining Federal Reserve behavior. Combining the behavioral assumptions of the policy rule with the output and financial market models predicts how the Federal Reserve will react to disturbances to the economic system — hence, a "reaction function."

Previously estimated reaction functions have differed with respect to the choice of dependent and independent variables, the functional form employed, the time period used for estimation and the conclusions based on that estimation. They also have reached different conclusions about the stability of the estimated reaction function. Thus, it is useful to briefly survey previously estimated reaction functions.

Three variables commonly have been employed as the dependent variable, that is, as the measure of monetary policy. Niskanen (1978) and Barro (1977) among others use a measure of the money stock, M1, assuming that the money stock is the best indicator of monetary policy during the period of estimation. Froyen (1974), Levy (1981), and Barth, Sickles, and Wiest (1982) use the monetary base instead, contending that the base corresponds more closely to open market operations and is a good measure of exogenous monetary policy actions. The third alternative, used by Abrams, Froyen, and Waud (1980), DeRosa and Stern (1977), and Havrilesky, Sapp, and Schweitzer (1975), is the federal funds rate. They argue that this variable is a more appropriate measure of monetary policy in periods in which the Federal Reserve is targeting on interest rates. They further contend that the Federal Reserve, in fact, has targeted interest rates during most of the post-World War II period.

Previously estimated reaction function estimates also have used a wide range of independent variables and have assumed alternate goals of the Federal Re-

[7]See Lombra and Moran (1980) and Wallich and Keir (1979).

[8]See Thornton (1983) and the sources cited there.

[9]For example, see Allen and Smith (1983), Barth, Sickles, and Wiest (1982), Froyen (1974), Hamburger and Zwick (1981, 1982), Levy (1981), McMillin and Beard (1980, 1982). Two studies that do not use the reaction function approach are Dwyer (1982) and Thornton (1984). For a detailed statement of the deficit problem, see Tatom (1984).

serve (e.g., price stability, low unemployment, high real growth rates and financial market stability). Most previous studies have used ordinary least squares (OLS) estimation techniques, and independent variables generally are included with no more than one lag.[10]

The estimation results have been inconsistent in a number of respects. For example, using the monetary base as the policy measure, Allen and Smith (1983) found that the unemployment rate was significant, while Levy (1981) found it insignificant. On the impact of the debt, included as a measure of financial market stability, Levy concluded that debt growth influenced monetary policy, while Hamburger and Zwick (1981) reached exactly the opposite conclusion. On the stability of the estimated reaction function, Allen and Smith (1983) argued in favor of a stable relationship; Abrams, Froyen, and Waud (1980) reported findings of instability. It is unclear to what extent these differences are due to different sample periods, the choice of independent variables, the specification of the monetary policy variable or the use of different functional forms.[11]

EMPIRICAL METHODOLOGY

The basic reaction function approach is also employed here. Two alternative monetary policy measures are used as dependent variables: the money stock (M1) and the federal funds rate (i_{FF}), given that the Federal Reserve has alternately focused on interest rates and the money stock.[12] To further allow comparison of the estimation results with the potential relationships between monetary policy and deficits as presented in table 1, we employ two measures of debt growth in the following empirical analysis: the net federal debt (NFD) and the high employment deficit (HEBD).[13]

[10]Levy (1981) used instrumental variables and Abrams, Froyen, and Waud (1980) used 3SLS. Froyen (1974) and studies using Barro's (1977) basic specification used more than one lag.

[11]See Barth, Sickles, and Wiest (1982) or McMillin and Beard (1981) for a more extensive review of the reaction function literature.

Thornton (1984) uses a different framework focusing on the "causal" relationships between monetary policy and debt rather than using a reaction function approach. His results are consistent with the findings of the reaction function literature. There apparently exists a relationship between monetary policy and federal debt, but this finding is sensitive to the period of analysis chosen as well as the precise measure used for debt.

[12]The monetary base is not used as a measure of monetary policy since Thornton (1984) has shown the linkage between debt growth and the monetary base is influenced by a number of other factors.

[13]Previous reaction functions have generally used either NFD or HEBD although Froyen (1974) used both in the same equation.

Neither of these two measures is a perfect indicator of the pressure on the Federal Reserve to alter policy in response to changes in federal debt. NFD is potentially influenced by macroeconomic shocks, which may also have an impact on (or be the result of) monetary policy. Thus, NFD includes both structural and cyclical components. NFD does have the advantage of including off-budget items, and the recent growth in off-budget items may represent substantial additional pressure on monetary policymakers.[14] The HEBD measure is adjusted for real income changes.[15] Thus, it may be considered a measure of structural policy changes. HEBD, however, does not include off-budget items.

The equations are estimated over the interval from I/1958 to III/1984 (except where noted) as well as over the subperiods from I/1958 to IV/1970 and from I/1971 to III/1984. The entire period is best characterized in terms of table 1 as a mixed targeting procedure. The early subperiod is basically a time of interest rate targeting, while the latter conforms most closely to a monetary aggregate targeting procedure.

The estimated equations are of the form presented below, a specification similar to that of Froyen (1974):

$$(1)\ X_t = \alpha_o + \sum_{i=1}^{I} \alpha_i X_{t-i} + \sum_{j=0}^{J} \beta_j Z_{t-j} + \sum_{k=0}^{K} \gamma_k D_{t-k}$$

where X ≡ a measure of monetary policy;

Z ≡ a vector of measures of the goals and constraints of the Federal Reserve;

D ≡ a measure of debt;

and α, β, and γ are the estimated parameters.

The right-hand-side variables include lags of the dependent variables as well as current and lagged values of the stabilization objectives or goals used by the Federal Reserve.[16] Included in the specification are the general price level (P), the unemployment rate (UR), and alternately each of the two measures of federal debt. Following the previous reaction function

[14]For example, off-budget items totaled $17.3 billion in fiscal year 1982.

[15]See deLeeuw and Holloway (1982).

[16]Froyen has noted that the estimated reaction function actually represents a joint test of the influence of the chosen stabilization goals and constraints together with the appropriateness of the chosen dependent variable. Lags of the dependent and independent variables are included (1) to allow gradual adjustment to goals so that monetary policy is not a source of instability and (2) to capture the effect on monetary policy of variables omitted from the model.

literature, interest rate terms are included in the money equation, while money terms are included in the interest rate equation.

All variables were included in log difference form except for HEBD, which is included in level form. Maximum lag lengths were arbitrarily restricted to 12 lags on the dependent variables and six lags for the other right-hand-side variables. The choice of appropriate lag length was then determined by Akiake's final prediction error (FPE) criterion.[17] When the FPE search for the preferred lag specification indicated that no values of a right-hand-side variable improved the specification, that variable was dropped from the basic equation. Except when noted, a variable was included in the estimated equation only when an F-test on its joint coefficients indicated it was significant at the 10 percent level. Two-stage least squares was used as the estimation technique to avoid problems of simultaneity.[18]

ESTIMATION RESULTS

The reaction function results estimated over the 1958–84 period are presented in tables 2 and 3. Tables 4 and 5 include the results of equations estimated from 1958 to 1970, while tables 6 and 7 present results of equations estimated over the 1971–84 interval. The focus of the following discussion is on the debt variable and the extent to which federal deficits have influenced monetary policy. The debt coefficients are interpreted in light of the predicted coefficient signs from table 1.

Full Period Results

Table 2 presents the equations estimated initially with NFD as an independent variable. The top part of the table presents the coefficient sums and the t-statistics on whether that sum is significantly different from zero. At the bottom of table 2, the significance values are presented for the joint hypothesis that all the coefficients for a particular variable are equal to zero. These significance levels are presented since the lag lengths and corresponding degrees of freedom vary from one specification to another. The lag lengths are included in parentheses. Zero indicates that only the contemporaneous variable is included.

Since net federal debt, on average, had no significant impact on money during the 1958–84 period, it was omitted from the M1 equation. NFD is included in the

Table 2

Basic Results Using NFD: I/1958–III/1984

	M1	i_{FF}
c	.003	−.011
	(2.01)	(−.33)
ΣM	.833	3.316
	(6.76)	(.93)
ΣUR	−.043	−1.256
	(−2.60)	(−2.97)
Σi_{FF}	−.021	−.144
	(−2.34)	(−.86)
ΣP		2.746
		(.77)
ΣNFD		−2.555
		(−1.97)
$\bar{R}^2$	.39	.54
RMSE	.0065	.122
Q(20)[1]	9.09	17.90
Significance levels[2]		
M	.0001	.0102
	(9)	(1)
UR	.0110	.0001
	(0)	(2)
i_{FF}	.0056	.0214
	(2)	(2)
P		.0001
		(4)
NFD		.1175
		(1)

[1]The Q-statistic tests for autocorrelation in the presence of lagged dependent variables. It follows a chi-square distribution and is calculated for 20 degrees of freedom. The critical value at the 95 percent level is 31.41.

[2]Given the varying degrees of freedom, the significance levels of the joint F-statistics are presented. The number of lags are included in parentheses.

[17]See Batten and Thornton (1984). In one instance below, the FPE chose the maximum lag length allowed. In that case, the maximum lag length was increased but further lags were insignificant.

[18]Only one equation is estimated, and this period's inflation, unemployment rate, etc., may be influenced by this period's monetary policy. In the first stage, each of the dependent variables was regressed on 10 lags of itself and four lags of all other variables in the model. The maximum lag lengths were arbitrarily restricted. The second stage, reported in the text, replaces the current values of the independent variables with the first stage estimates. If HEBD were an exogenous policy tool, the use of an instrument for HEBD would be unnecessary. There is no reason, however, to assume that current fiscal policy is independent of, say, current monetary policy actions.

Table 3

Basic Results Using HEBD: I/1958–III/1983[1]

	M1	i_{FF}
c	.007 (3.74)	.003 (.10)
ΣM	.399 (2.50)	1.279 (.39)
ΣUR	−.029 (−1.94)	−1.389 (−3.12)
Σi_{FF}	−.012 (−1.68)	−.149 (−.85)
ΣP		.214 (.06)
ΣHEBD	.00026 (4.08)	
$\bar{R}^2$	.45	.53
RMSE	.0063	.125
Q(20)	14.47	23.14
Significance levels		
M	.0392 (5)	.0058 (1)
UR	.0554 (0)	.0001 (2)
i_{FF}	.0379 (1)	.0965 (2)
P		.0001 (4)
HEBD	.0003 (1)	

NOTE: See footnotes to table 2.

[1]Equations including HEBD are estimated only through III/1983 since the data series has been discontinued.

federal funds rate equation since the sum of its coefficients is significant at the 10 percent level. A 1 percent increase in NFD lowers the federal funds rate by an estimated 2.56 percent. Since NFD contains both structural and cyclical components, based on table 1, it appears that the cyclical component of NFD dominates the structural component in the federal funds rate equation. Further, since NFD significantly enters the federal funds rate equation, the Federal Reserve apparently did not follow a pure interest rate strategy over the 1958–84 period. This result is consistent with the hypothesized mixed targeting procedure.[19]

The HEBD results presented in table 3 apparently yield conclusions at odds with these results. With the HEBD measure, the deficit has a significant positive impact on the money stock but no impact on the federal funds rate; consequently, it was omitted from the final estimated federal funds equation. Given HEBD as a measure of the structural deficit, the impact of HEBD on M1 and i_{FF} is consistent with the Federal Reserve, on average, pursuing an interest rate targeting strategy during the 1958–84 period.

The conditions presented in table 1, however, represent only sufficient conditions for the structural deficit to have no impact on the federal funds rate. In other words, it is not necessary for the Federal Reserve to be targeting interest rates in order to generate the result that HEBD does not influence i_{FF}. For example, if HEBD is small relative to the loanable funds market or if the supply of loanable funds is interest-elastic, then HEBD would have little influence on i_{FF} even with, say, a mixed targeting strategy.

Further, there is evidence to suggest that the structural deficit represents a relatively small fraction of the total demand for loanable funds. For example, in 1982, HEBD averaged $32.6 billion while net credit market borrowing by nonfinancial sectors was $404.1 billion. Thus, the HEBD component of federal borrowing was only 8.1 percent of funds borrowed. In contrast, on average from 1975 to 1981, similar figures indicate HEBD was only 4.6 percent of net funds borrowed. HEBD may have little or no impact on interest rates not because of the particular targeting procedure used by the Federal Reserve, but rather because of the small relative size of the structural deficit. Given this interpretation, the results in table 3 are also consistent with a mixed targeting strategy.

[19]The coefficients on the non-debt terms in table 2 deserve comment. Inflation does not significantly enter the M1 equation and unemployment enters with a negative coefficient.

While the negative coefficient on the unemployment rate is significant in all equations, its economic impact is minor. For example, a reduction in the unemployment rate from 7.5 percent to 7.0 percent would increase the growth rate of money by only 0.2 percent. The procyclical response of monetary policy to the unemployment rate is certainly not intuitive; it is, however, consistent with the findings of Abrams, Froyen and Waud (1980).

Although the sum of the coefficients on the inflation term in the federal funds rate equation is not significant, the joint impact is significant. The short-run impacts are large in magnitude although approximately offsetting over a year. Similarly, the sum of the coefficients on money growth in the federal funds rate equation are not significantly different from zero. Again, it is the result of offsetting individual coefficients.

Table 4

Interest Rate Target Using NFD: I/1958–IV/1970

	M1	i_{FF}
c	.001	−.008
	(.27)	(−.23)
ΣUR	−.064	−1.860
	(−2.86)	(−5.60)
Σi_{FF}	−.065	−.159
	(−5.15)	(−1.29)
ΣP	1.164	6.861
	(6.83)	(1.58)
ΣNFD	.281	−.842
	(2.29)	(−.32)
$\bar{R}^2$	.67	.67
RMSE	.0038	.110
Q(20)	23.05	11.41
Significance levels		
UR	.0001	.0001
	(4)	(0)
i_{FF}	.0001	.0001
	(2)	(2)
P	.0001	.0024
	(1)	(1)
NFD	.0275	.0045
	(0)	(1)

NOTE: See footnotes to table 2.

Table 5

Interest Rate Target Using HEBD: I/1958–IV/1970

	M1	i_{FF}
c	.005	−.019
	(3.02)	(−.54)
ΣUR	−.031	−2.017
	(−1.42)	(−5.72)
Σi_{FF}	−.053	−.044
	(−4.03)	(−.35)
ΣP	.789	6.757
	(3.60)	(1.42)
ΣHEBD	.00029	
	(3.09)	
$\bar{R}^2$	.69	.59
RMSE	.0037	.121
Q(20)	30.54	17.69
Significance levels		
UR	.0001	.0001
	(4)	(0)
i_{FF}	.0002	.0031
	(2)	(2)
P	.0001	.0136
	(1)	(1)
HEBD	.0132	
	(1)	

NOTE: See footnotes to table 2.

Subperiod Results

The reaction function results estimated over the interval from I/1958 to IV/1970, which corresponds to what is commonly thought to be a period of interest rate targeting, are presented in tables 4 and 5. The estimation procedures are identical to those employed for the entire period results above. When NFD is used as the debt measure, its coefficients are jointly significant in both the money stock and federal funds rate equations. A 1 percent increase in NFD would result in a permanent 0.28 percent increase in the money stock. In contrast, in the federal funds rate equation, while the NFD coefficients are jointly significant, their sum is not significantly different from zero. An increase in NFD this period will be accompanied by lower interest rates this period, but that decline in the federal funds rate will be offset next period, with the funds rate returning to its previous level. Thus, the NFD results are consistent with interest rate targeting, assuming a one-quarter lag before the Federal Reserve can effectively offset interest rate changes.

The HEBD results in table 5 generally are consistent with the NFD results. HEBD is significant in the money equation but insignificant in the federal funds rate equation. An increase in the structural deficit leads to an increase in the money stock during the early period but has no effect on the federal funds rate. This HEBD result is also consistent with interest rate targeting. The NFD and HEBD results differ only in their timing. NFD has a slightly faster impact on the money stock

Table 6

Mixed Targeting Procedure Using NFD: I/1971–III/1984

	M1	i_{FF}
c	.020	−.146
	(4.69)	(−1.08)
ΣM		8.246
		(1.26)
ΣUR		−1.372
		(−3.01)
Σi_{FF}	−.006	−.547
	(−.77)	(−2.06)
ΣP	−.350	8.549
	(−1.65)	(1.59)
ΣNFD	.087	−3.613
	(1.14)	(−2.28)
$\bar{R}^2$	.21	.58
RMSE	.0072	.111
Q(20)	9.81	11.34
Significance levels		
M		.0097
		(6)
UR		.0052
		(1)
i_{FF}	.0202	.0228
	(1)	(2)
P	.1047	.0967
	(0)	(3)
NFD	.2616	.0882
	(0)	(1)

NOTE: See footnotes to table 2.

Table 7

Mixed Targeting Procedure Using HEBD: I/1971–III/1983

	M1	i_{FF}
c	.020	−.210
	(3.87)	(−1.35)
ΣM		9.589
		(1.22)
ΣUR		−1.562
		(−3.23)
Σi_{FF}	−.005	−.427
	(−.64)	(−1.59)
ΣP	−.298	5.611
	(−1.17)	(1.06)
ΣHEBD	.00014	
	(1.64)	
$\bar{R}^2$	.25	.57
RMSE	.072	.116
Q(20)	9.06	6.38
Significance levels		
M		.0089
		(6)
UR		.0047
		(1)
i_{FF}	.0542	.0551
	(1)	(2)
P	.2474	.0663
	(0)	(3)
HEBD	.1083	
	(0)	

NOTE: See footnotes to table 2.

and a temporary effect on the federal funds rate. HEBD takes one quarter longer in reaching its full impact on money and has no effect on the federal funds rate.[20]

Equations estimated only over the 1971–84 period, which corresponds to a period of greater reliance on a monetary aggregate target, are presented in tables 6 and 7. The NFD and HEBD equations both imply that debt growth did not influence the money stock over this period. Again, when the federal funds rate equation is estimated with NFD, that variable is significant; when it is estimated with HEBD, the deficit measure is insignificant. As in the discussion of the complete period results, the finding that HEBD has not influenced the federal funds rate may be due more to the small size of the structural deficit vs. total credit demand than it is to the targeting procedures of the Federal Reserve.[21] Thus, the later period estimation results are

[20]With respect to the non-debt terms, there are some interesting differences between the early period and the full period results, in particular for the money stock equation. The money stock continues to respond countercyclically to unemployment, but it also responds countercyclically to inflation in the early period. Also, lagged money terms are insignificant.

[21]Even for the first three quarters of 1983, the last period for which HEBD is available, the structural deficit increases to only 10.4 percent of net credit market borrowing. Of course, the insignificance of HEBD could also be a result of other causes. For example, believers in currency substitution would argue that any increase in HEBD leading to increased real interest rates would also lead to foreign capital inflows that could drive interest rates back to approximately their original levels.

consistent with the Federal Reserve following a monetary aggregate target.

The federal funds rate equations estimated over the later period were similar to those for the early and the full periods. In contrast, the money stock equations were substantially different in the later period. The money stock equations chosen by Akiake's FPE and F-tests consistently imply that virtually all variables entered, with the possible exception of the federal funds rate and the inflation rate, are insignificant.

From the perspective of estimating a reaction function that "explains" much of the variation in the money stock, the 1971–84 results leave much to be desired. They are, however, consistent with two very different theories of Federal Reserve behavior. First, it is possible that over this period the goals of the Federal Reserve or the weights on those goals were changing frequently, perhaps due to shifts in money demand, deregulation or financial innovations. If true, it would be impossible to estimate a consistent relationship between goals and the money stock. In the extreme, the money stock after detrending would be a random walk. Alternately, the Federal Reserve, on average, may have followed a constant money growth rate rule. In this case, the money stock after detrending would also be a random walk. Either of these hypotheses would be consistent with a poorly performing short-run reaction function for the money stock.

SUMMARY AND CONCLUSIONS

This paper has examined whether federal debt growth has influenced alternate measures of monetary policy. It was demonstrated that a structural deficit would have very different implications than a cyclical deficit. A structural deficit in the static model presented here could lead to an increase in money growth and/or interest rates. In contrast, a cyclical deficit could be accompanied by a decrease in money growth and/or interest rates. Whether debt alters money growth or interest rates depends on the nature of the targeting strategy used by the Federal Reserve.

The results of a reaction function, developed and estimated over alternate intervals, suggest that prior to 1971 debt growth did lead to money growth but did not influence interest rates. Since then, debt growth has not altered money growth but may have been associated with interest rate changes. Net federal debt growth, which combines both structural and cyclical debt changes, is accompanied by a lower federal funds rate for the 1971–84 period. This result suggests that cyclical debt changes dominate structural in NFD's effect on interest rates. In contrast, the high-employment budget deficit, a measure of structural debt changes only, has had no impact on the federal funds rate over any time period. This result may be due to HEBD's small size in comparison with total credit demands.

The results presented here are consistent with monetary policy being independent of federal deficits even though money market variables do apparently respond to those deficits. During the period when the Federal Reserve was targeting interest rates, the assumed policy measure, the federal funds rate, was unaffected by federal deficits. While the money stock does respond to deficits in the early time period, 1958–70, the money stock was not being used as a policy target in that interval. Conversely, in the later period, 1971–84, the Federal Reserve paid more attention to the money stock and less to interest rates. In that interval, the primary policy variable, the money stock, was again unaffected by federal deficits while those deficits may have had an impact on interest rates.[22]

REFERENCES

Abrams, Richard K., Richard Froyen and Roger N. Waud. "Monetary Policy Reaction Functions, Consistent Expectations, and The Burns Era," *Journal of Money, Credit and Banking* (February 1980), pp. 30–42.

Allen, Stuart D., and Michael D. Smith. "Government Borrowing and Monetary Accommodation," *Journal of Monetary Economics* (November 1983), pp. 605–16.

Barro, Robert J. "Unanticipated Money Growth and Unemployment in the United States," *American Economic Review* (March 1977), pp. 101–15.

Barth, James R., Robin Sickles and Philip Wiest. "Assessing the Impact of Varying Economic Conditions on Federal Reserve Behavior," *Journal of Macroeconomics* (Winter 1982), pp. 47–70.

Batten, Dallas S., and Daniel L. Thornton. "How Robust Are the Policy Conclusions of the St. Louis Equation?: Some Further Evidence," this *Review* (June/July 1984), pp. 26–32.

Darby, Michael R. "Some Pleasant Monetarist Arithmetic," Federal Reserve Bank of Minneapolis *Quarterly Review* (Spring 1984), pp. 15–20.

deLeeuw, Frank, and Thomas M. Holloway. "The High-Employment Budget: Revised Estimates and Automatic Inflation Effects," *Survey of Current Business* (April 1982), pp. 21–33.

DeRosa, Paul, and Gary H. Stern. "Monetary Control and the Federal Funds Rate," *Journal of Monetary Economics* (April 1977), pp. 217–30.

Dwyer, Gerald P., Jr. "Inflation and Government Deficits," *Economic Inquiry* (July 1982), pp. 315–29.

[22]One hypothesis not tested here is that the Federal Reserve has shifted targets, say, from monetary aggregates to interest rates, in response to federal deficits. This change would represent another way in which debt growth could influence monetary policy.

Eisner, Robert, and Paul J. Pieper. "A New View of the Federal Debt and Budget Deficits," *American Economic Review* (March 1984), pp. 11–29.

Froyen, Richard T. "A Test of the Endogeneity of Monetary Policy," *Journal of Econometrics* (July 1974), pp. 175–88.

Hamburger, Michael J., and Burton Zwick. "Deficits, Money and Inflation," *Journal of Monetary Economics* (January 1981), pp. 141–50.

________. "Deficits, Money and Inflation: Reply," *Journal of Monetary Economics* (September 1982), pp. 279–83.

Havrilesky, Thomas, Robert H. Sapp and Robert L. Schweitzer. "Tests of the Federal Reserve's Reaction to the State of the Economy," *Social Science Quarterly* (March 1975), pp. 835–52.

Hoffman, Dennis L., Stuart A. Low and Hubert H. Reineberg. "Recent Evidence on the Relationship between Money Growth and Budget Deficits," *Journal of Macroeconomics* (Spring 1983), pp. 223–31.

Levy, Mickey D. "Factors Affecting Monetary Policy in an Era of Inflation," *Journal of Monetary Economics* (November 1981), pp. 351–73.

Lombra, Raymond E., and Herbert M. Kaufman. "The Money Supply Process: Identification, Stability, and Estimation," *Southern Economic Journal* (April 1984), pp. 1147–59.

Lombra, Raymond and Michael Moran. "Policy Advice and Policymaking at the Federal Reserve," in Karl Brunner and Allan H. Meltzer, eds., *Monetary Institutions and the Policy Process,* Carnegie-Rochester Conference Series on Public Policy (Autumn 1980), pp. 9–68.

Makin, John H. "Real Interest, Money Surprises, Anticipated Inflation and Fiscal Deficits," *Review of Economics and Statistics* (August 1983), pp. 374–84.

McMillin, W. Douglas, and Thomas R. Beard. "Deficits, Money and Inflation: Comment," *Journal of Monetary Economics* (September 1982), pp. 273–77.

________. "The Impact of Fiscal Policy on the Money Supply in the U.S.: Theory and Empirical Evidence," *Rivista Internazionale di Scienze Economiche e Commerciali* (1981), pp. 941–57.

________. "The Short Run Impact of Fiscal Policy on the Money Supply," *Southern Economic Journal* (July 1980), pp. 122–35.

Miller, Preston J., and Thomas J. Sargent. "A Reply to Darby," Federal Reserve Bank of Minneapolis *Quarterly Review* (Spring 1984), pp. 21–26.

Niskanen, William A. "Deficits, Government Spending, and Inflation: What is the Evidence?" *Journal of Monetary Economics* (August 1978), pp. 591–602.

Plosser, Charles I. "Government Financing Decisions and Asset Returns," *Journal of Monetary Economics* (May 1982), pp. 325–52.

Potts, Glenn T., and Dudley G. Luckett. "Policy Objectives of the Federal Reserve System," *Quarterly Journal of Economics* (August 1978), pp. 525–34.

Sargent, Thomas J., and Neil Wallace. "Some Unpleasant Monetarist Arithmetic," Federal Reserve Bank of Minneapolis *Quarterly Review* (Fall 1981), pp. 1–17.

Tatom, John A. "A Perspective on the Federal Deficit Problem," this *Review* (June/July 1984), pp. 5–17.

Thornton, Daniel L. "Monetizing the Debt," this *Review* (December 1984), pp. 30–43.

________. "The FOMC in 1982: De-Emphasizing M1," this *Review* (June/July 1983), pp. 26–35.

Wallich, Henry C., and Peter M. Keir. "The Role of Operating Guides in U.S. Monetary Policy: A Historical Review," *Federal Reserve Bulletin* (September 1979), pp. 679–90.