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Some Problems of Money Demand

THE CURRENT ECONOMIC upturn has been characterized by unusually low rates of money growth relative to the increase in nominal gross national product. Even more surprising, the unusual rise in velocity has occurred while short-term interest rates have remained largely unchanged or even fallen slightly (see table 1). This development contradicts much of the supposed knowledge about the public's demand for money and its determinants. The present shortfall of money demand from its expected value has important consequences for current monetary policy and the increased uncertainty about the demand for money in the future has implications for the conduct of policy generally.[1] The first section of this paper describes the magnitude of the problem. The second section briefly reviews a simple version of the theory of money demand in order to provide a framework for examining causes of the problem. It lists some potential inadequacies of the theory and data and then focuses on current developments that are not embodied in the simple theory and that might help explain recent money demand. The next section presents some empirical tests, and the final section offers conclusions.

Note: The views expressed in this paper are our own and do not necessarily reflect those of the Federal Reserve Board or its staff.

1. This discussion is limited to the *demand* for money and hence to the stock that will be held, given income and interest rates. The money stock has also generally been on the low side of publicly announced target values, but that is beyond the scope of this paper. These targets could have been met by supplying more bank reserves, but that technique would have led to even lower interest rates and higher incomes. The money-demand puzzle would remain.

Table 1. Short-Term Interest Rates, and Growth Rates of GNP and Demand Deposits, Quarterly, 1975–1976:1

	Interest rate		*Seasonally adjusted annual growth rate*	
Year and quarter	*Treasury bills*	*Commercial paper*	*Gross national product*	*Demand deposits*[a]
1975:1	5.75	6.56	−2.1	1.1
2	5.39	5.92	7.7	10.1
3	6.33	6.67	19.9	1.6
4	5.63	6.12	12.1	0.0
1976:1	4.92	5.29	11.5	5.4

Sources: *Federal Reserve Bulletin*, vol. 62 (April 1976), pp. A 12 and A 27, and ibid. (February 1976); Board of Governors of the Federal Reserve System, Statistical Release H.6, May 13, 1976; U.S. Bureau of Economic Analysis, release BEA 76-28, April 19, 1976.

a. Derived from the average of demand deposits at commercial banks for the end-of-the-quarter month and the following month.

The Recent Shortfall in Demand-Deposit Balances

The point of departure for our discussion is the money-demand equation contained in the MPS (MIT-Penn-Social Science Research Council) econometric model.[2] The MPS specification of the demand for money is representative of the most common type of money-demand function.[3] The equation as originally estimated is

$$\ln \frac{DD}{XGNP\$} = \underset{(-4.1)}{-0.519} + \underset{(1.6)}{0.280} \ln \frac{DD_{-1}}{XGNP\$} \underset{(-5.1)}{-0.062} \ln RTB \underset{(-5.1)}{-0.123} \ln RS$$
$$\underset{(-2.3)}{-0.339} \ln \frac{XGNP}{N} + \underset{(3.9)}{0.078} \ln \frac{RDISC}{RDISC_{-1}},$$

where

DD = demand deposits at commercial banks measured as the two-month average surrounding the end of the quarter

$XGNP\$$ = GNP in current dollars

2. Since the phrase "demand for demand deposits" is awkward, we use the word "money" to mean demand deposits unless otherwise indicated. The usual definition of money—M_1—includes both currency and demand deposits owned by the nonbank public. Since currency demand has recently behaved in accord with expectations, the mystery is confined to demand deposits.

3. The MPS equation is broadly consistent with the money-demand equations developed in Stephen M. Goldfeld, "The Demand for Money Revisited," *BPEA, 3:1973*, pp. 577–638.

$XGNP$ = GNP in 1958 dollars
RTB = the Treasury bill rate
RS = the average offering rate on time and savings deposits at commercial banks and thrift institutions
N = the U.S. population
$RDISC$ = the Federal Reserve discount rate.

The coefficient estimates, based on data from 1955:2 to 1972:4, emerge from an iterated instrumental-variable estimate of the equations for money demand and free reserves at banks (money supply). In estimating, the coefficient on the rate on time and savings deposits was constrained to be twice that on the bill rate. Prediction errors from this equation in the post-sample period, 1973:1–1976:1, are shown in the first two columns of table 2.

Early in 1974, when it appeared that the developing recession might be deeper and last longer than any within the sample period of the equation, the existing equation was modified by replacing current real GNP per capita by the highest real GNP per capita ever achieved. This change reflected the hypothesis that economies instituted in the management of cash balances as transactions grew at most were reversed very slowly when transactions shrank. This modification to the income variable made very little difference to predicted values between 1957 and mid-1974, so in view of the complexity of the estimation technique, the equation was not reestimated. The modification did, however, make a difference after mid-1974. Prediction errors from the altered equation are presented in the last two columns of table 2.

The equation shows some tendency to overproject from the very beginning of the post-sample period. Until late 1974, however, the errors are not unusual for an econometric equation simulated beyond the sample period. And with the altered form of the equation, they are not especially unusual until the summer of 1975. At that point, with recovery under way, one would have expected rapid money growth, rising short-term interest rates, or both, depending on monetary policy. That these expectations failed to materialize is mirrored in the huge overpredictions of money demand in the latest quarters shown in table 2. Clearly, both the original and the altered form of the equation, which incorporates much of the conventional wisdom regarding the determinants of money demand, miss an important part of the story.

Table 2. Post-Sample Dynamic Simulation Errors, MPS Model Demand-Deposit Equation, Quarterly, 1973–1976:1[a]

	Equation as estimated		*Equation with altered income term*	
Year and quarter	*Actual less predicted (billions of dollars)*	*Percent of deposits*	*Actual less predicted (billions of dollars)*	*Percent of deposits*
1973:1	−4.4	−2.2	−4.4	−2.2
2	−1.8	−0.9	−1.8	−0.9
3	−0.8	−0.4	−0.8	−0.4
4	−0.5	−0.2	−0.5	−0.2
1974:1	−0.9	−0.4	0.5	0.2
2	−1.8	−0.8	0.4	0.2
3	−7.1	−3.3	−4.1	−1.9
4	−12.2	−5.7	−7.0	−3.3
1975:1	−14.6	−6.8	−6.2	−2.9
2	−13.7	−6.2	−4.4	−2.0
3	−19.0	−8.6	−12.0	−5.4
4	−26.4	−11.9	−20.2	−9.1
1976:1	−32.7	−14.6	−26.1	−11.6

Sources: Text equation 1, and equation 1 modified by replacing current real gross national product per capita with the highest per capita GNP ever achieved. The sample period is 1955:2–1972:4.

a. Due to recent revisions in the national income accounts, data needed to simulate this equation, which is based on the old data, are available only through the third quarter of 1975. The data for subsequent quarters were generated by applying percentage changes calculated from the new data.

Potential Problems with the Model

The MPS money-demand equation—with GNP and two interest rates as principal explanatory variables—is consistent with the models of Baumol, Tobin, and Miller and Orr, which emphasize the transactions demand for money.[4] Recently, Ando and Shell have developed a rigorous extension of this approach to money demand by demonstrating that, in the presence of a riskless interest-bearing asset, desired money balances will depend only on the value of transactions and the spread between the rate of return

4. See W. J. Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," *Quarterly Journal of Economics*, vol. 66 (November 1952), pp. 545–56; James Tobin, "The Interest-Elasticity of Transactions Demand for Cash," *Review of Economics and Statistics*, vol. 38 (August 1956), pp. 241–47; Merton H. Miller and Daniel Orr, "A Model of the Demand for Money by Firms," *Quarterly Journal of Economics*, vol. 80 (August 1966), pp. 413–35.

on the riskless asset and on money.[5] In the Ando-Shell model, money demand is independent of wealth, the inflation rate, and the rate of return on equities.

All of these theoretical specifications lead to very similar estimating equations. Our discussion is organized around the original Baumol specification because it is the simplest. The Baumol equation is

$$M = \sqrt{\frac{bT}{2i}},$$

where

M = desired money balances
b = the fixed cost (brokerage fee) of converting money to interest-bearing assets or vice versa
T = the total value of transactions
i = the interest rate available on earning assets.

Any theoretical model, no matter how complex, is necessarily a vast oversimplification of reality, and its empirical counterparts involve inevitable compromises between the theory and available data. Thus, the empirical MPS model is subject to a variety of potential problems from misspecification that may have been important in recent quarters and that may help explain the unusual weakness in money demand.

AGGREGATION

Theoretical money-demand models are applicable to the individual or business firms and imply economies of scale in money demand. The MPS equation estimates desired money balances for the national economy. Thus, an examination of the distribution of money balances by ownership, geographical location, and size of bank provides a natural starting point for an investigation of the sources of weak money demand. Table 3, which presents data from the Federal Reserve Board's regular survey of demand-deposit ownership, reveals no unusual shifts in the pattern of ownership in recent quarters that would suggest a need to disaggregate. Unfortunately,

5. Albert Ando and Franco Modigliani (appendix with Karl Shell), "Some Reflections on Describing Structures of Financial Sectors," in *The Brookings Model: Perspective and Recent Developments* (Amsterdam: North-Holland, 1975; available from American Elsevier).

Table 3. Gross Demand Deposits of Individuals, Partnerships, and Corporations, at All Commercial Banks, by Ownership Category, Quarterly, 1970–75

Percentage shares

Year and quarter	*Total*	*Ownership category*				
		Financial business	*Nonfinancial business*	*Consumers*	*Foreign*	*All other*
1970:2	100.0	10.50	52.49	30.12	0.96	5.92
3	100.0	10.14	52.45	30.62	0.82	5.97
4	100.0	9.89	52.93	30.59	0.73	5.87
1971:1	100.0	10.70	50.50	31.83	0.80	6.17
2	100.0	10.28	51.00	31.99	0.75	5.99
3	100.0	10.07	51.45	32.31	0.70	5.48
4	100.0	9.84	52.45	31.27	0.71	5.73
1972:1	100.0	11.14	51.10	30.21	0.75	6.80
2	100.0	9.51	51.81	32.10	0.74	5.84
3	100.0	9.19	51.97	32.28	0.73	5.83
4	100.0	9.08	52.85	31.45	0.72	5.90
1973:1	100.0	9.32	51.41	32.54	0.85	5.88
2	100.0	9.00	51.66	32.64	0.99	5.71
3	100.0	8.94	51.50	32.86	1.02	5.68
4	100.0	8.66	52.78	31.83	1.11	5.62
1974:1	100.0	8.94	51.34	33.43	1.08	5.20
2	100.0	8.48	52.12	33.21	1.03	5.15
3	100.0	8.26	52.52	33.19	0.98	5.05
4	100.0	8.42	52.72	32.63	1.01	5.21
1975:1	100.0	8.58	51.47	33.84	1.02	5.05
2	100.0	8.75	51.80	33.65	1.03	4.77
3	100.0	8.38	52.29	33.71	0.96	4.66
4	100.0	8.48	52.82	32.92	1.02	4.77

Sources: *Federal Reserve Bulletin*, relevant issues (the numbers here were calculated from unrounded data in the Federal Reserve data bank).

the time series are not long enough to tell much about the past cyclical behavior of ownership patterns. Perhaps the unusual aspect of this cycle is that no shift in shares occurred. But with the data at hand, it appears that any unusual recent economies in the management of cash balances have been shared by all classes of deposit ownership.

Table 4 presents annual changes in member-bank deposits broken down by Federal Reserve district and size of bank since 1969. These figures sug-

Table 4. Changes in Money-Supply Deposits at Member Banks, by District and Size of Bank, 1969–75

December-to-December changes, in millions of dollars, not seasonally adjusted

Bank size and period	Total[a]	Federal Reserve district[b]												New York City	Chicago
		1	2[c]	3	4	5	6	7[d]	8	9	10	11	12		
Large banks															
1969–73, yearly average	3,545	81	37	64	172	224	265	180	85	37	84	167	1,014	745	224
1974	3,349	−253	−64	6	179	−8	50	136	75	19	−163	221	725	655	299
1975	−82	133	−6	−81	80	60	119	−96	37	−17	142	214	798	−818	72
Small banks															
1969–73, yearly average	3,243	60	280	118	272	511	708	497	190	180	398	469	240	...	...
1974	−97	−197	−205	−383	208	−45	−106	−74	54	45	59	50	53	...	...
1975	2,420	35	378	21	132	220	213	183	129	200	291	668	171	...	...

Sources: Board of Governors of the Federal Reserve System, Banking Section, Division of Research and Statistics.

a. Includes adjustments for foreign and mutual savings bank demand deposits at member banks and float.

b. The districts are: 1, Boston; 2, New York; 3, Philadelphia; 4, Cleveland; 5, Richmond; 6, Atlanta; 7, Chicago; 8, St. Louis; 9, Minneapolis; 10, Kansas City; 11, Dallas; 12, San Francisco.

c. Changes for large banks outside New York City.

d. Changes for large banks outside Chicago.

gest that the 1974–75 weakness in money growth was widespread, implying that any new ability to conserve money balances apparently has been geographically dispersed.

In principle, aggregation can cause trouble in other ways. For example, if the distribution of individual income becomes more uneven or if the dispersion of business-firm size becomes greater, a reduction in aggregate money balances relative to aggregate income would be expected. The recession just past may have widened inequality of these sorts. But it would take implausibly large distributional shifts to exert a noticeable effect on aggregate money demand.

MEASURES OF INTEREST RATES

The next class of problems concerns a lack of agreement between the variables appearing in the empirical equations and the concepts assumed by the theory. In principle, all short-term interest rates should be represented. In practice, the Treasury bill rate probably represents free-market interest rates satisfactorily. For one thing, most short-term instruments are very good substitutes and their rates tend to be highly correlated. For another, the relevant rate on long-term instruments is not the stated yield but rather the expected rate for holding over a short period, which includes both the market yield and expected capital gains and which has been shown to be closely related to short-term rates. Thus, the bill rate seems an acceptable proxy for all market rates. We have tried other market rates and combinations of rates but to small reward.

Yields on savings deposits are represented separately in the MPS equation because the rates on these important money substitutes are regulated and often do not behave like market rates. The term RS is an arbitrarily weighted average of the rates paid on passbook savings and consumer certificates of deposit. The passbook rate by itself might be a better choice since the rates paid on certificates with a maturity of several years are unlikely to be relevant to the desired level of money balances. Moreover, a meaningful aggregate rate is difficult to construct because of the many maturities on CDs. As it is now constructed, therefore, RS has a large and growing arbitrary component.[6]

6. Another problem is that our equation fails to take into account the implicit rate paid on demand deposits. To attract depositors, banks provide a number of services,

MEASURES OF TRANSACTIONS

The use of gross national product to represent transactions is subject to a number of criticisms. It ignores transfer payments and transactions on capital account (for example, trading in the stock market), both of which require some cash balances. An increase in the integration of firms, or a shift in the composition of GNP from less integrated to more integrated industries or from private to government expenditures, would reduce transactions for intermediate output and depress desired money balances.

Although bank debits have sometimes been used as the transactions variable in money-demand equations, for our purposes this strategy presents some problems.[7] Data on total debits have so much short-run variability that monthly or quarterly equations are difficult to construct. In addition, we have no idea how to predict debits in the short term.

In looking for the effects of changes in the composition of output, Richard Porter of the Federal Reserve staff has subtracted debits in New York City, which are heavily influenced by financial transactions, from total debits, and calculated the ratio of this series to GNP. The ratio, depicted in figure 1, shows moderate volatility prior to 1962. It has some tendency to fall in recessions and to begin a sharp rise one quarter after cyclical troughs. After 1962, the ratio exhibits a steady or even accelerating rise right through the 1970 recession to the end of 1974, when it abruptly reverses. After the 1974–75 recession, only a slight upturn occurs three quarters after the cyclical trough.

Since the Korean War, the ratio of debits to GNP has risen smoothly enough that the reversal does not appear to be random. One possible reason for it might be a fall in the volume of financial transactions relative to GNP. Another might be a fall in the volume of intermediate transactions relative to GNP (for example, a shift in the composition of output toward integrated firms). Whatever the source, figure 1 suggests a shift in the relation between GNP and the volume of transactions unlike any in nearly two decades. This area bears further investigation.

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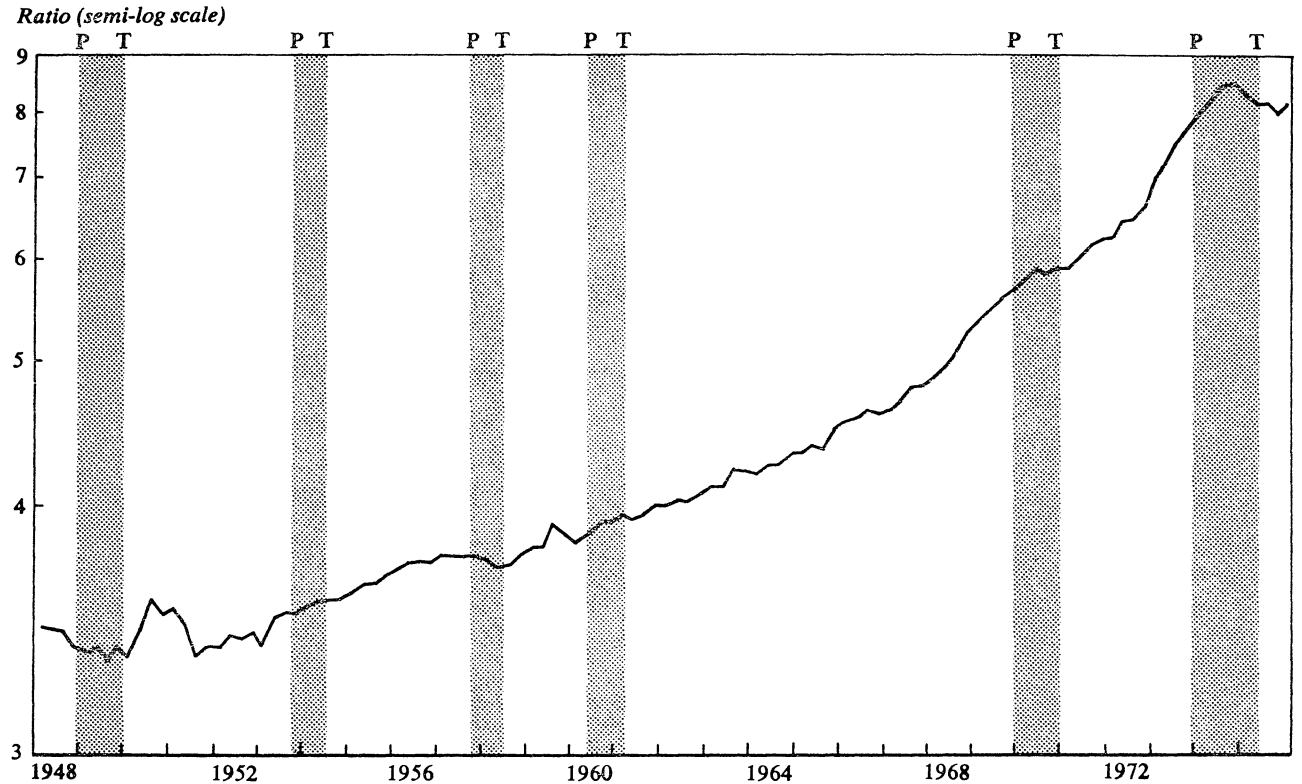
whose level may vary over time. Some observers expect this variation to be nearly equal to the variation in market interest rates and therefore expect very low measured interest-rate elasticities.

7. Bank debits are the value of checks written on privately held demand deposits at commercial banks. These data are available monthly in the *Federal Reserve Bulletin*, statistical section, page A 11.

Figure 1. Ratio of Bank Debits, Excluding New York City, to Gross National Product, Quarterly, 1948–1976:1[a]



Sources: Provided by Richard Porter, Federal Reserve staff. The basic data are the official bank-debit series of the Federal Reserve Board, published in *Federal Reserve Bulletin*, and the gross national product series of the U.S. Department of Commerce, published in *Survey of Current Business*.

a. *P* = peak of the business cycle; *T* = trough.

BROKERAGE FEES

Econometric equations include no measure of the brokerage fee that is part of the theoretical model of money demand. The implicit assumption that it is constant is questionable. Even in the absence of innovation or changes in market structure, brokerage costs might change. For an individual, this cost may consist mainly of the value of the time it takes to go to the bank and transfer funds from a savings to a demand account; this value may rise with secular increases in income and wealth, thus causing money holdings to rise. A decrease in wealth, like that in the 1973–75 recession, could, by the same argument, reduce money demand.

Financial innovation may also change brokerage costs, but in the opposite direction. One example is overdraft credit lines. Although few data exist on this practice, informal surveys by the Federal Reserve indicate that a majority of banks offered this service at the end of 1975. Furthermore, a significant number of depositors make moderately active use of the privilege. Estimating the effect on money balances is difficult, however. Even if it is unused, the very existence of the privilege allows economies in money management since the depositor knows any overdraft will be covered.

Money-market mutual funds, which invest shareholder funds in short-term money-market instruments, are another innovation that reduces the brokerage fee. Funds invested can be redeemed quickly, usually at no cost, by wire transfer or by a check written by the shareholder at a commercial bank designated by the fund. As table 5 indicates, these funds grew rapidly in 1974 and the first half of 1975, although total assets have declined since then. Most of these investments probably came from direct money-market obligations or from time and savings deposits, but some probably came from money balances.

In September 1975, member banks were permitted to make third-party nonnegotiable transfers from savings accounts for any purpose. Previously, such transfers had been authorized only for mortgage-related expenditures. Informal bank surveys indicate that as of December 1975, this service was not widely offered by banks or widely used by customers where it was available. Although their potential effect is considerable, these transfers probably have affected money balances very little thus far.

Another innovation, which reduces the brokerage fee for some large businesses, is the bank-managed account. At the end of each day banks automatically invest in an overnight money-market instrument all funds above

Table 5. Outstanding Balances in Innovative Accounts That Serve as Money Substitutes, 1974–75

Millions of dollars

Year and month	*Money-market mutual funds*	*Negotiable orders of withdrawal*	*Business savings at weekly reporting banks*[a]
1974			
January	174	143	...
February	208	150	...
March	244	165	...
April	303	174	...
May	412	180	...
June	542	191	...
July	792	204	...
August	1,106	232	...
September	1,393	249	...
October	1,860	270	...
November	2,208	293	...
December	2,439	312	...
1975			
January	3,043	339	...
February	3,501	385	...
March	3,786	449	...
April	3,862	472	...
May	3,911	514	...
June	3,795	580	...
July	3,694	630	...
August	3,787	670	...
September	3,750	713	...
October	3,723	761	...
November	3,704	796	241
December	3,645	839	756

Source: Federal Reserve Board.

a. A Federal Reserve survey as of January 7, 1976, indicated that about one-half of all business savings balances are held at weekly reporting banks. Total business savings for November and December are therefore probably about twice those shown here.

an agreed-upon minimum balance. This practice may be growing, although data to confirm it are lacking.

A number of regulatory changes have also worked to lower the brokerage fee. In April 1975, the telephone transfer of funds between savings and demand-deposit accounts was authorized. By eliminating the trip to the bank, this change significantly reduces the brokerage fee for households, and has a large potential impact on desired demand balances. Banks responding to

informal surveys did not believe that telephone transfers, though offered by a large percentage of banks, had yet had a significant effect on demand balances. Low usage of this device, however, does not necessarily mean it has little effect on desired cash balances. As in the case of overdraft credit lines, mere availability would tend to reduce money balances.

In November 1975, member banks were permitted to offer savings accounts to businesses. These deposits totaled nearly $2 billion by early January 1976, of which an estimated $1¼ billion were drawn off from demand deposits; growth accelerated in the second week of January, after slowing during the last half of December. The December slowdown probably resulted from the end of the initial conversion of demand deposits into savings accounts. The January acceleration coincided with the drop in the Treasury bill and CD rates below the 5 percent savings deposit ceiling. These January inflows, therefore, appear to have come largely at the expense of market securities and time deposits rather than demand deposits.

DEFINING MONEY

Some regulatory changes have led to the growing importance of accounts that are virtually perfect substitutes for demand deposits but are not counted in the money stock. One example is negotiable orders of withdrawal (NOW) accounts, which are interest-bearing accounts at commercial banks and thrift institutions on which checks can be drawn.[8] Until the beginning of 1976, they were limited to New Hampshire and Massachusetts, and they are not counted in the money stock. While percentage rates of growth are high, these accounts have grown by less than a billion dollars in the past two years (see table 5). As of the beginning of the year, NOW accounts were authorized in four additional northeastern states and their growth should accelerate.

Drafts on credit union shares look and function much like checks. When the draft reaches the credit union's bank, the credit union is notified and authorizes a debit to its account. Currently, the dollar amounts cleared through this arrangement are trivial, but the practice is spreading rapidly. In August 1975, only sixteen credit unions were providing this service; by the beginning of 1976, the number had reached fifty-five.

8. Another example is payment orders of withdrawal (POW) accounts, which are essentially noninterest-bearing checking accounts at mutual savings banks. The dollar volume of POW accounts is as yet negligible, amounting to less than $100 million.

Other problems with the measurement of money balances are not related to recent regulatory changes. One that has stimulated considerable discussion is the practice of including in the statistics on demand deposits balances held by foreign commercial banks, central banks, and other official institutions. These holdings are reported in table 6. It is generally believed that such balances are held for foreign-exchange clearing purposes or for other financial transactions unrelated to domestic economic activity. These deposits dropped by $1 billion in 1975 after having risen between $2 billion and $3 billion in the preceding two years. Eliminating them from the money-stock numbers would have caused the errors in predicting money demand shown in table 2 to begin earlier and to grow more smoothly.

BUSINESS LOANS

Finally, it has been suggested that the drop of about $10 billion in business loans between late 1974 and February 1976 caused a contraction in deposits through a reduction in compensating balances. We are somewhat skeptical of the causal relationship between business loans and the money stock. Even if compensating-balance requirements amounted to 25 percent of outstanding loans—and all these balances were idle—the reduction in business loans could account for only a little over 10 percent of the shortfall in M_1 displayed in table 2.[9] Nevertheless, we did examine the hypothesis that deposits depend on business loans by fitting regressions with business loans as an explanatory variable. With quarterly data, the coefficient had the wrong sign. We conclude that the falloff in business loans has contributed little to the recent weakness in money demand.

9. Any link between the money stock and business loans through compensating balances requires that a significant part of such balances would not be held if they were not required. However, a case can be made that compensating balances largely represent active balances. It is well known, for example, that because of capital restrictions firms must spread their borrowings over a number of banks. In the absence of such restrictions, these firms might hold all checking balances at one bank. However, since the firm needs to hold a certain level of demand balances for transaction purposes, it incurs little additional expense by maintaining these multiple accounts. It may thus regard compensating-balance requirements as only a very small increase in the effective loan rate. To banks, of course, the balances are important and each applies a requirement to protect its share of transaction deposits. But, as long as compensating balances represent mainly working balances, reductions in business loans per se should have no effect on the level of demand balances. Of course, the distribution throughout the banking system could change, with banks experiencing the biggest loan runoffs also suffering a drop in share of total deposits.

Table 6. Foreign-Owned Demand Deposits in U.S. Banks, 1971–75
Millions of dollars

End of year	*Foreign official institutions*[a]	*Foreign banks*	*Total*	*Change from previous year*
1971	1,327	3,399	4,726	...
1972	1,591	4,658	6,249	1,523
1973	2,125	6,941	9,066	2,817
1974	2,951	8,248	11,199	2,133
1975	2,644	7,549	10,193	−1,006

Sources: *Federal Reserve Bulletin*, vol. 61 (September 1975), and vol. 62 (April 1976), p. A 63 in each.
a. Deposits of foreign central banks are included in those of official institutions.

New Money Equations

We next incorporate some of the proposed explanations for the recent behavior of money demand into new estimating equations. This step serves two purposes. First, it provides a more formal test of the proposed explanations. Second, extrapolations of these equations will offer a measure of the uncertainty about the current state of money demand. In particular, it is important to know if money demand will be less predictable in the future than it has been until recently. Knowing its predictability relative to that of the relationship between interest rates and aggregate expenditure is important for choosing instruments for conducting monetary policy. If the demand for money is quite unpredictable, the case for conducting policy by regulating the growth of the money supply is seriously weakened.

A representative sample of newly estimated money-demand equations is reported in table 7. Unlike the MPS equation above (which was estimated by the method of iterated instrumental variables), these equations were all estimated using a simple Cochrane-Orcutt least-squares procedure and are all based on the revised national income data. Although an average of time and savings deposit rates (used in the current MPS equation) produces somewhat better results historically than does the commercial bank passbook rate, the latter is used in the table 7 equations since the former has become rather arbitrary in recent years. Finally, the ratio of the current to the lagged discount rate has been dropped from the reported equations because its contribution was almost always insignificant. When the MPS equation is reestimated by the same single-stage estimation procedures and over the same sample period, the estimated speed of adjustment and the

Table 7. Estimated Money-Demand Equations, Using the Ratio of Demand Deposits to GNP as the Dependent Variable, Sample Period, 1955:2–1974:2[a]

Equation	Ratio of demand deposits in preceding period to GNP in current period	Real GNP per capita	Interest rate			Wealth		Ratio of loans to GNP	ρ	Standard error[b]	Error of prediction for 1976:1[c]
			Treasury bills	Commercial paper	Commercial bank passbooks	Level	Percent change				
7.1	0.77	−0.11	−0.018	...	−0.040	...	...	...	0.26	0.56	8.5
	(10.9)	(1.8)	(5.0)		(3.1)						
7.2	0.71	−0.15	...	−0.023	−0.052	...	...	...	0.25	0.54	9.3
	(10.8)	(2.6)		(6.0)	(4.2)						
7.3	0.70	−0.17[d]	−0.019	...	−0.052	...	...	...	0.27	0.55	7.3
	(9.9)	(2.7)	(5.0)		(3.8)						
7.4	0.84	−0.08	−0.011	...	−0.028	0.019	0.21	...	−0.04	0.51	10.6
	(15.4)	(1.5)	(2.8)		(2.4)	(0.8)	(4.1)				
7.5[e]	0.72	−0.15	−0.018	...	−0.052	...	...	...	0.26	0.55	7.1
	(10.0)	(2.4)	(5.1)		(3.7)						
7.6[e]	0.65	−0.17	−0.017	−0.004[d]	−0.059	...	...	...	0.29	0.53	6.7
	(8.7)	(2.8)	(4.9)	(3.4)	(4.4)						
7.7	0.65	−0.19	−0.016	−0.002[d]	−0.064	...	...	...	0.30	0.54	5.8
	(8.4)	(3.0)	(4.6)	(2.2)	(4.4)						
7.8	0.66	−0.16	−0.016	...	−0.055	...	...	−0.047	0.35	0.56	8.2
	(8.0)	(2.4)	(4.1)		(3.8)			(1.9)			

Source: Authors' money-demand equations using a Cochrane-Orcutt least-squares procedure and the 1976 revision of the national income data.

a. All variables enter logarithmically except peak commercial paper rate, which enters arithmetically in equations 7.6 and 7.7, and the percent change in wealth, which enters arithmetically in equation 7.4. The numbers in parentheses are *t*-statistics.

b. The standard error is reported as a percentage of the dependent variable.

c. The extrapolation error is the percent error in 1976:1 of a dynamic simulation begun in 1974:3.

d. The variable entered here is the past highest value.

e. A proxy for transactions, which is described in the text, was substituted for GNP in the dependent and independent variables of this equation.

income and interest elasticities are similar to those of the equations reported in table 7. The last column of the table shows the percentage errors in predicting money demand in the first quarter of 1976.

The first equation reported is the simplest plausible money-demand expression, including only income, a market interest rate, and a deposit interest rate. The most notable difference between this and the MPS equation reported above is the rather slower speed of adjustment, a property shared by all of the equations and a consequence of using the simpler Cochrane-Orcutt procedure. In the dynamic prediction, equation 7.1 overestimates money demand for 1976:1 by 8.5 percent, an unimpressive performance.

Equation 7.2 differs from equation 7.1 only in replacing the Treasury bill rate by the commercial paper rate. This substitution yields, at best, a slight gain within the sample (in this case the standard error falls from 0.56 to 0.54) and worsens the predictive performance of the equation. These same changes in performance proved to be the case when this substitution was made in the other equations.

In equation 7.3, the real income term in 7.1 is replaced by the previous peak level of real income, the same alteration that showed some forecasting improvement in table 2. The parameter estimates seem equally reasonable, the sample fit is about the same, and the post-sample prediction is improved. However, by the second quarter of 1976, the dynamic prediction will probably be no better than that of equation 7.1 since real income will have about reached its previous peak.

Some models of money demand require wealth or the rate of change in it as a determinant.[10] Equation 7.4 shows the result of entering both the level and the rate of change of household net worth in the money-demand equation. The level has little effect, but the rate of change enters strongly. Equations estimated with this term invariably have better sample-period fits than do the same equations without it; in addition, serial correlation of the residuals is eliminated. These equations have only one drawback: post-sample predictions are uniformly disastrous, as they are with equation 7.4.

Equation 7.5 attempts to incorporate some of the information contained in bank debits. We argued earlier that GNP is a flawed proxy for transactions and that in some ways debits would be better. On the other hand, the debits series is volatile and does not work particularly well in a quarterly money equation. Moreover, no one knows how to predict debits. To get

10. Goldfeld, "Demand for Money Revisited."

around this obstacle we regressed debits on the various expenditure categories of GNP and used the results to construct a transactions variable as a weighted sum of GNP expenditure components. In this new transactions variable, residential construction received a weight of 1.5, exports received a weight of 0.5, and government purchases of labor services a weight of zero, while all other GNP expenditure categories received a weight of 1.0.

This new transactions variable was then used in place of GNP as the "income variable" in equation 7.5—both in the definition of the dependent variable and as an explanatory variable. The result is a slight improvement in sample-period fit and a substantial reduction of post-sample error. It appears that this line of inquiry should be pursued further.

Equation 7.6 explores the possible asymmetry between increases and decreases in interest rates. The notion is that when interest rates rise to unprecedented levels, steps are taken to economize on cash balances. If the costs of economizing are partially fixed costs (say, the cost of writing a cash-management computer program), a subsequent reduction in interest rates may not cause cash balances to rise by the same amount as the earlier decline.

To test this hypothesis, equation 7.6 contains a term in the previous peak interest rate, entered arithmetically rather than logarithmically. The term is significant and has the expected sign. This equation seems superior to equation 7.1 in all respects. The adjustment speed is faster, the sample fit is better, and the projection error is substantially reduced. This change in the basic equation appears very promising.

Equation 7.7 incorporates the changes in both equations 7.5 and 7.6. It provides the best post-sample predictions of any of the equations tried. The equation is remarkably insensitive to market interest rates while they are below their past peak, however, and the income elasticity is somewhat lower than theory suggests. Furthermore, the post-sample errors, while reduced, are still enormous.

Finally, equation 7.8 uses the ratio of commercial loans to income to test the argument that business loans have a special role in stimulating money demand by generating compensating balances in excess of cash balances that would otherwise be held. This variable has the opposite sign of that expected and the statistical performance of the equation is essentially unchanged from that of equation 7.1.

At this point we are still unable to produce a satisfactory econometric demand-deposit equation. Evidence suggests that taking account of the

different money requirements of various types of GNP expenditures and the lasting effect of past peaks in interest rates will improve the ability to predict, but the results are still unsatisfactory.

Conclusions

At this point it seems unlikely that we can develop a simple, reliable, money-demand equation. Our best efforts so far, using published demand-deposit data, overestimate by about 6 percent in the first quarter of 1976. Perhaps we could improve this performance by constructing new equations based on deposit data that exclude foreign bank and official deposits, but include NOW accounts. Doing so would probably reduce our recent errors by $4.5 billion to $5 billion, but would still leave a substantial error that cannot be accounted for directly. In earlier sections of this paper, we have speculated that much of the weakness in money demand reflects innovations and regulatory changes that have reduced the costs of converting assets between money and interest-bearing instruments or developments that have reduced the volume of transactions per dollar of GNP.

Such speculation raises some fundamental questions. First, are the hypothesized causes of the weakness likely to disappear, remain as they are, or become stronger? Second, will the demand for money become less predictable than it has been until recently? Third, if it does become less predictable, what are the implications for policy?

Overdraft accounts, telephone transfers, drafts on credit union shares, business savings accounts, and third-party transfers appear to be with us for the foreseeable future; their effects seem likely to increase as more financial institutions offer them and more depositors learn how to use them. Furthermore, other innovations of this kind will probably appear, facilitated by the reduction in bookkeeping costs made possible by computerization. Competition between banks and thrift institutions should heighten the tendency for all of them to offer depositors new ways to earn interest on what are essentially demand accounts. How far this development will go and how quickly seem to be unpredictable.

The evidence from the debits data suggests that a longer-run tendency toward increasing transactions per dollar of GNP has been reversed. Whether this reversal has contributed to the problem is as unclear as its causes. Moreover, its future path remains uncertain.

On balance, then, we believe that the weakness in demand deposits is likely to deepen; but we are not sure, and we certainly cannot predict the speed. In this light, new doubt arises about the advisability of setting policy targets in terms of M_1. One factor in the choice of monetary policy instruments is the relative stability of the money-demand relation compared with the relation of real expenditures to interest rates. It is widely accepted that the more stable the former relationship is relative to the latter, the more likely is a policy target using monetary aggregates to outperform an interest-rate instrument in achieving target values for expenditures. The deeper uncertainty in predicting money demand suggests paying more attention than formerly to other aggregates and to interest rates in formulating monetary policies.

Discussion

ROBERT HALL noted that the average velocity of money of about five that is observed in the aggregate statistics is wildly inconsistent with the observed behavior of most individuals, suggesting that the commonly used model of money demand seriously misses explaining aggregate money demand. There are apparently large components of money demand that require alternative explanations. James Tobin remarked that business deposits, in particular, cannot be explained by the inventory model of money demand, and thought that compensating balances represented the most promising avenue for improving the explanation. He was not persuaded by Enzler's dismissal of the compensating-balance argument and noted that in 1975, business loans had fallen for the first time in the history of the series, after rising very persistently at an average annual rate of about 10 percent since 1959. Deposits are probably not held against currently outstanding loans as much as against some weighted average of past and expected loans. Thus, the expectation of a shift from reliance on loans to open market instruments and from short-term to long-term borrowing might explain the decline in money demand better than Enzler's attempt had. Daniel Brill agreed with Tobin's views about the importance of business loans and compensating balances and suggested that these balances might be related to