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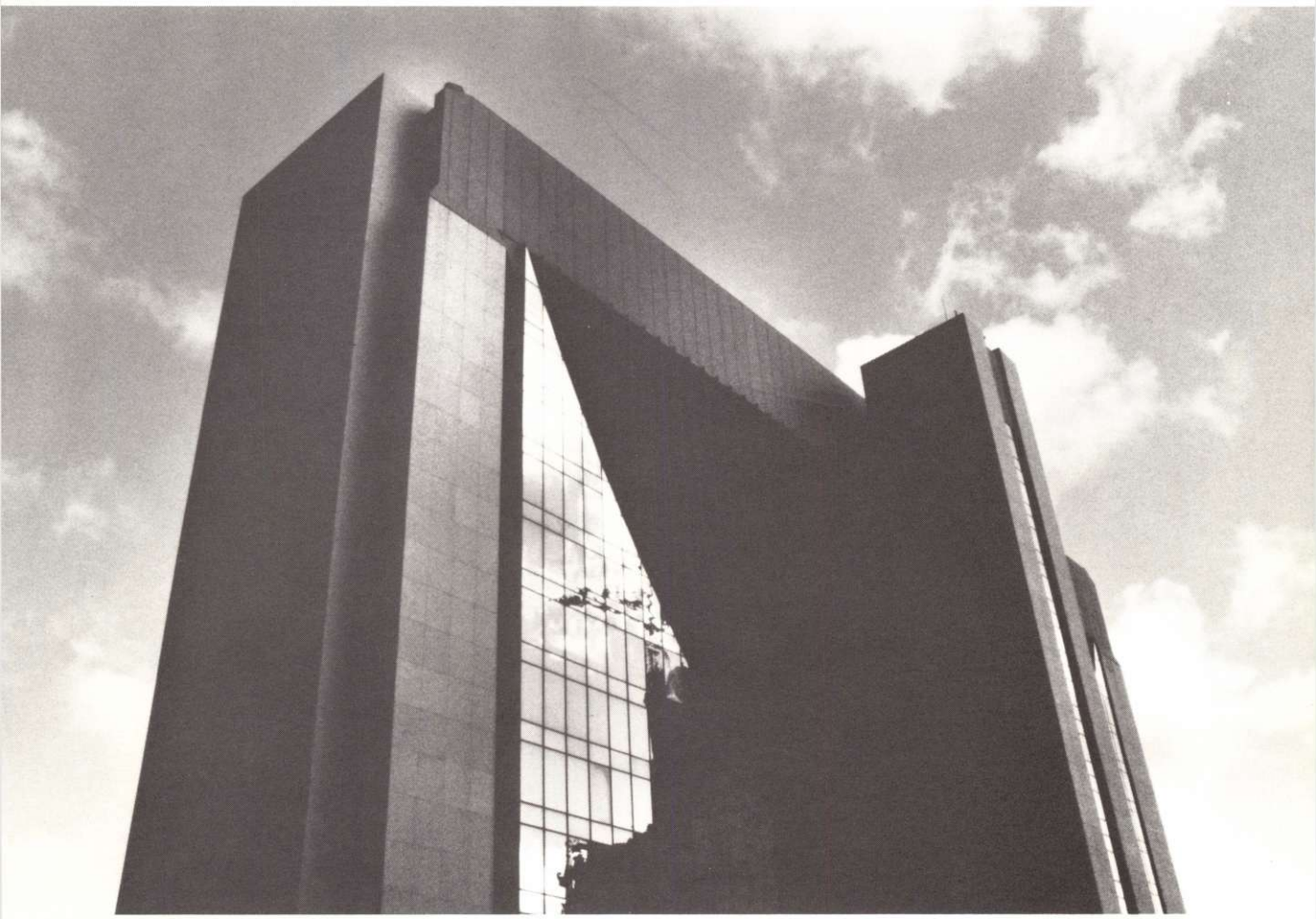

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The Search for a Stable Money Demand Equation

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The ability to predict fairly accurately how much of its wealth the public will want to hold as money is important for monetary policymaking as it is currently practiced. The Federal Reserve must set target levels for the money supply which will help the nation reach its goals for unemployment, inflation, and economic growth. To set the targets, one of the many tools the Fed uses is an equation which describes the historical relationships of things like spending and interest rates to the money balances that people hold. Assuming various growth rates of money and using this equation in conjunction with others, the Fed can predict the corresponding levels of the related variables to help it choose the rate most appropriate for the nation's goals.

For quite some time, however, this equation has not been reliable. It never was a perfect predictor of money demand, but in the mid-1970s it overshot actual levels by surprisingly large amounts, and since then its errors have only gotten larger. The equation has become statistically *unstable.* That is, the historical relationships between money demand and its determinants—as estimated in the coefficients of the equation—have been changing in unpredictable ways over time. In order to project historical relationships between variables and come close to what the actual levels for those variables will be, the relationships obviously must remain fairly stable.

Much effort has been expended to search for a stable money demand equation. Researchers have tried using different variables in the equation, variables which they thought might be more closely related to money demand. Recently the Fed and others have tried using different definitions of money, recognizing the rapid growth in financial assets other than the traditional bank checking accounts and cash. So far, however, none of these efforts has significantly improved the forecasting ability of the money demand equation.

Considering the economic theory underlying this equation, we aren't surprised by that failure. The equation does not take account of how people really decide how much money they want to hold, especially when their options are changing as rapidly as lately. The underlying theory suggests that the equation won't be able to accurately predict the public's demand for money until the financial industry settles down, and that's not likely to be soon.

More important for the Fed, recent theoretical analysis suggests that even then the equation will be useless as a policy tool. Thus, model builders concerned with evaluating the effects of alternative economic policies should not be tinkering with the standard macroeconomic equation, but rather changing their whole approach to modeling economic behavior.

A Demonstration of the Equation's Failure

The magnitude of the recent prediction errors of the money demand equation can be demonstrated by the performance of a representative equation. We estimated the relationships between money holdings and some fairly standard determinants for the period starting in the fourth quarter of 1960 and ending in the second quarter of 1974 (see the accompanying table). Then the equation was used to project what money demand would be in the next 22 quarters. The accompanying chart shows the results for what used to be the Fed's

A Representative Money Demand Equation for Real M-1*

Sample Period: 1960:4–1974:2

Determinant	Coefficient	*t*-statistic
Constant	.2520	1.39
Real GNP	.1556	3.67
3-month Treasury bill rate	–.0107	2.30
Commercial bank passbook rate	–.0362	1.96
Lagged dependent variable	.7267	6.55

Related Statistics

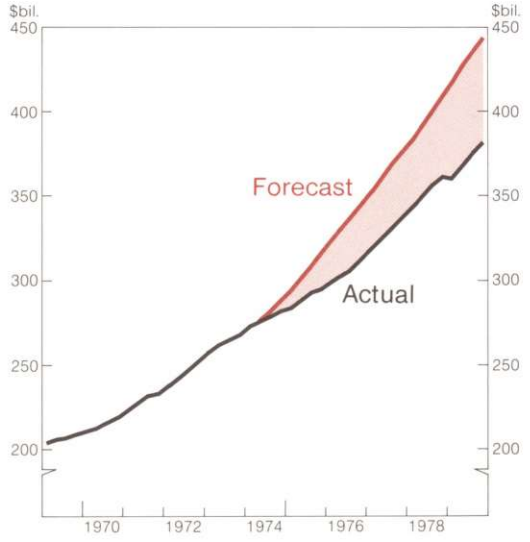
Rho	.4826
$\bar{R}^2$	.9768
Standard error of estimate	4.0581×10^{-3}
Sum of squared residuals	7.9049×10^{-4}
Durbin *h*-statistic	1.91
Number of observations	53

*All variables are in log form. Real variables are nominal values deflated by the implicit GNP deflator. The lagged dependent variable is the lagged nominal stock of money divided by the current value of the GNP deflator.

Coefficient estimates were obtained by applying the Cochrane-Orcutt procedure of iterative least squares.

Forecasted and Actual Levels of M-1

Quarterly, Forecasted 1974:3–1979:4
Actual 1969:1–1979:4



Sources: Forecast—Dynamic simulation of the standard equation described in the accompanying table
Actual—Board of Governors of the Federal Reserve System

most basic measure of money: M-1, those things people were thought to use most often to make payments—currency and checking accounts at commercial banks.

The equation overpredicted demand by increasingly larger amounts over the nearly six-year period. It started out with an error of $2 billion in the third quarter of 1974, which more than doubled to $5 billion in the next quarter. The error expanded to $20 billion one year later and by mid-1977 measured $36 billion. In the remaining quarters, the error broadened further, first only slightly but then quite a bit, until in late 1979 it reached $62 billion.

As dramatic as that looks, only statistical tests can tell whether or not this equation is stable, for even stable equations make bigger errors the further out they forecast. We estimated new coefficients for the equation over the forecast period (mid-1974 through 1979) and compared them statistically to the coefficients for the earlier period. The hypothesis that the coefficients were the same in both periods was rejected at the 5 percent level of significance. According to the test, that is, this equation is not stable.[1]

The Economic Theory Behind the Equation

Just what is wrong with the equation has been the subject of much study since the mid-1970s. Researchers have taken two basic approaches to the problem, both of which are based on a common economic theory.

To be able to write equations to predict what the total demand for money will be in the whole economy, one must first be able to explain what determines a person's or firm's demand for money. Economists usually do this by assuming that, in this as in every other economic situation, individuals want to do the best they can for themselves.

[1] An equation for M-2, the Fed's slightly broader measure of money, performed just about as badly. Meant to represent the media of exchange plus the assets most easily converted into those media, M-2 includes M-1 plus time and savings deposits at commercial banks (excluding large certificates of deposit). The failure of this equation indicates that the M-1 equation was not failing simply because people were shifting more money than usual from cash and checking accounts into time and savings accounts at banks.

Individuals start a particular time period with some wealth, and during the period they add to that wealth by earning income. They also spend during the period, paying current prices to acquire goods and services. Some of the spending is planned—regular bill payments that can be fairly well known in advance. Some is unexpected—buying on impulse or for emergencies, for example. To handle this spending, individuals must hold money (the current means of payment) which traditionally does not pay interest, but money is only one of a variety of ways they can hold their wealth. Stocks, bonds, and savings accounts, for example, do pay dividends or interest, which makes them more attractive than the means of payment. Converting these other assets into the means of payment costs something, though: the time, trouble, and money it takes to get to the bank or broker and make the exchange.

What individuals will want to do, economists theorize, is allocate their wealth among money and other assets so that they maximize the return they can get from nonmoney assets over and above the costs of converting what they must into money.

The total demand for money in the economy in any period, then, will be the sum of all individuals' demand for money and can be represented in an equation by aggregate measures of the factors determining the demand of individuals:

- how much wealth or income they have
- how much they must spend
- how uncertain they are about spending
- how much interest can be made on other assets (the opportunity cost of holding money)
- how much converting other assets to money costs (the transaction costs).

The Standard Equation

The equation which most economists have used to predict the demand for money has not included explicit aggregate measures of all these factors. Both income and spending are typically represented by one measure, since all spending becomes somebody's income. That measure is gross national product (GNP), which in the equation is separated into its two components, real GNP, a measure of the physical goods and services produced, and the GNP deflator, a measure of their current prices. The opportunity cost of holding money is usually represented by one or two short-term interest rates, often the rate on commercial bank passbook savings accounts and the rate on three-month Treasury bills. However, the standard equation does not include measures of either the uncertainty about spending or transaction costs because there simply are no good ones. How, for example, do you measure the costs of things like a trip to the bank to withdraw money or to a broker to cash in securities?

Economists have included in the standard equation a factor not otherwise prescribed by the one-period theory above: the level of the money stock in the previous period. Economists have assumed that, when conditions change, people cannot immediately adjust their money holdings to the levels they would like. In any period, therefore, the amount of money held is assumed to be only part way between the desired amount implied by the theory and the actual amount held in the last period. Including last period's money stock in the standard equation can thus help predict what this period's will be.

One Approach: Replace the Determinants

One obvious way to try to correct an aggregate demand equation has been to replace and add to the usual aggregate measures of the determinants. Researchers have suspected that the standard equation may be failing because it's using poor representatives of those things theory says determine money demand or because it's simply omitting some. They have suggested some alternative and additional measures which they have then tested in the money demand equation. The hope has been that, through trial and error, variables which produce a stable equation will be found.

Suggested Alternative Variables

Some economists have argued that GNP isn't a very good proxy for income and spending. It measures total spending on final goods and services (those being bought by the ultimate user) in a given time period. In doing so, it excludes purchases of goods for resale or further processing, trade in used goods and existing real assets, and financial exchanges of things like stocks and bonds. Besides that, GNP includes some imputed values which are not measures of actual spending—estimates of the rental value of owner-occupied homes and the market value of food produced and consumed on farms. As an alternative for GNP in the demand equation, therefore, some researchers have suggested trying debits to demand deposits (the amount of checks written on bank checking accounts) since this

measure does not have GNP's exclusions or imputed values. Others have suggested household net worth, a measure of wealth, both as a replacement for GNP and as an added variable to distinguish between wealth and income effects.

Some researchers have suggested that individuals do not base their money holding decisions on the current level of prices, which the standard equation includes, but rather on "perceived" prices—the level people consider "normal." Researchers suggest that the standard equation would thus be improved by including a measure of how people form their perceptions of what is normal: some average of current and past price levels.

Several alternatives have been suggested for the standard measures of the opportunity cost of holding money. In hopes of finding a closer relationship to money demand, researchers have proposed trying substitutes for the three-month Treasury bill rate: the rate on short-term commercial paper, that on long-term U.S. government securities or corporate bonds, and the dividend-price ratio, which is meant to represent the yield on all physical capital. Other researchers think that a better alternative than rates on individual assets might be a measure of the entire term structure of interest rates, that is, the relationship between all assets' lengths of maturity and their yields. Still others have suggested adding inflation to the equation, as a representation of the rate of return that holding goods instead of money offers.

As we said, the uncertainty about spending is not included in the standard equation because it is not easy to measure. If this factor has remained constant, omitting it has not affected the equation's ability to predict the demand for money. Some researchers have suggested, however, that uncertainty was reduced significantly starting in 1973–74 when high interest rates induced many businesses to improve their cash management procedures.[2] By setting up a more extensive communications network or writing new computer programs then, they were able to know much more confidently what their needs for cash were in any subsequent period and so were able to hold smaller reserve balances. In effect, their demand for money was reduced.

Researchers trying to capture these effects in the money demand equation have considered the decision to adopt new cash management techniques as an investment problem which involves more than the one time period that the theory specifies. For the individual firm, adopting these procedures is an investment which has an immediate fixed cost but which will pay off over many periods in the future by allowing more of the firm's wealth to be held in interest-bearing assets. Businesses look ahead, therefore, and make this investment only when they expect interest rates to rise high enough to pay for the fixed cost of the investment. The demand for money will thus be reduced by the new procedures only when interest rates are unusually high and rising.

A way to get this into an aggregate equation, researchers say, is to first assume that all those who find it profitable to invest in the new techniques at current interest rates do so and that others do not find it profitable until rates have risen higher than they have been in the past. Then to the equation can be added a ratchet variable which measures the amount by which some representative interest rate currently exceeds its last peak. The variable would rise with market rates, reaching a peak itself whenever rates reached a new peak, and as it did, have a depressing effect on the demand for money.

Testing the Alternatives

One of the first empirical studies to test some of these suggested remedial measures was done by Enzler, Johnson, and Paulus (1976). Using as the sample period the second quarter of 1955 through the second quarter of 1974 (1955:2 through 1974:2), they reestimated the coefficients of the standard M-1 demand equation with replacements and additions to the set of determinants. Some of the variants they tried include replacing GNP with a debits-derived spending variable, adding household net worth and the change in net worth, replacing the bill rate with the rate on commercial paper, adding ratchet variables, and then combining some of these possibilities. After reestimation, the new equations were used to predict demand in the period 1974:3 through 1976:1. While several of the equations weren't as far off as the standard equation, none was able to lower the cumulative overprediction error by as much as one-half. Enzler, Johnson, and

[2]Some researchers have interpreted the effects of improved cash management procedures as reduced transaction costs rather than reduced uncertainty, but that difference is not crucial here.

Paulus admitted that they had not produced a satisfactory empirical demand function.

Goldfeld (1976) failed too. In an intensive study the alternatives and additions he tried include debits to demand deposits and household net worth for the spending or income variable; "perceived" prices instead of actual prices; the short-term commercial paper rate, the long-term corporate bond rate, and inflation for the opportunity cost variable; and ratchet variables. Besides these new variables, Goldfeld also tried using more sophisticated estimation techniques. Despite all that, he did not produce a stable demand equation. In an attempt to pinpoint the problem, he estimated separate demand equations for households, financial and nonfinancial business firms, state and local governments, and the rest of the world. On predicting 1974 and 1975, he found that these equations (especially the one for nonfinancial business firms) made substantial errors, substantial enough to conclude that a disaggregated approach to projecting total money demand was not any better than the aggregate approach.

One study appeared at first to have improved the standard equation. Hamburger (1977) estimated an M-1 equation for the sample period 1955:2 through 1972:4 in which he simply replaced the Treasury bill rate with the long-term U.S. government bond rate and the dividend-price ratio as more appropriate measures of opportunity cost. When put to work over the period 1973:1 through 1976:2, this equation overpredicted money demand in every quarter but one. The errors, however, were relatively small, much smaller than those in our table above. While Hamburger did not claim that his equation was stable, he did think that its determinants were more closely related to money demand than those usually used and that it was a better predictor than the standard equation.

Others have criticized Hamburger's equation, though. Porter and Mauskopf (1978) argued that the appropriate return on capital in a money demand equation is not the dividend-price ratio Hamburger used, but rather a nominal return that takes into account expected gains and losses. And this is not a minor misspecification, according to Porter and Mauskopf's test. When they set the dividend-price ratio at a fixed value to neutralize its effect, they found that an estimated version of Hamburger's equation overpredicted demand from 1974:3 to 1977:4 by as much as a standard equation. Though inappropriate theoretically, the dividend-price ratio was largely responsible for improving the empirical performance of the standard equation. Hafer and Hein (1979) found something wrong with Hamburger's equation too. They noted that in it the long-run elasticity of income (or the ratio of changes in money demand to changes in income) is constrained to one, even though other evidence suggests it is considerably smaller. When they relaxed this constraint, they found that over the period 1973:1 to 1977:1 the cumulative prediction errors more than doubled.

Most recently, researchers have examined the contention that the term structure of interest rates, rather than any individual rates, is the right measure of opportunity cost. Heller and Khan (1979) devised a set of three variables to concisely represent the term structure quarter by quarter and included them in a standard M-1 demand equation which they estimated for the period 1960:3 through 1976:4. They then statistically tested this equation over that same period and found it reasonably stable. They did not, however, check its forecasting performance for any later period, that is, for any period it was not explicitly designed to predict well. Porter and Mauskopf (1978) did. They estimated the same equation using data for the period 1960:3 through 1974:2 and then had it predict the next three and a half years. For this period, the equation's overprediction errors were very large, generally matching those of a more conventional equation. However desirable it may be theoretically to include term structure variables in the money demand equation, therefore, including them does not produce a reliable, stable equation.[3]

Another Approach: Redefine Money

The determinant approach to improving the money

[3]The contradictory results of these two studies appear to be due to the low power of the statistical tests Heller and Khan used to detect changes in the coefficients of their money demand equation. They first tested whether or not the coefficients followed a linear trend during the sample period instead of remaining constant and found that they did not, but this may or may not reveal anything about the possibility of a change in coefficients at the end of their period, namely, 1975–76. Their other two tests, labeled the *cumsums* and *cumsums-squared* tests, involved examinations of the one-period-ahead forecasting errors of the money demand equation. Garbade (1977), through a series of Monte Carlo experiments, has examined the power of both these procedures to detect a change in the slope coefficient of a two-variable model when the coefficient follows a random walk or makes a discrete jump in the middle of the data period or follows a stable Markov process. He found that the cumsums test was virtually powerless in all cases. The power of the cumsums-squared test varied from zero to 100 percent, depending on the pattern and degree of coefficient change. In the case of a discrete jump of 50 percent or less, its power was considerably less than 50 percent.

demand equation, then, has not been at all successful. Researchers have not been able to find better measures of the determinants of money demand. Of course, they have not yet tried everything, and one particular omission may be crucial. Economic theory considers transaction costs, or the costs of converting financial assets into something which can be exchanged for goods and services, as an important determinant of money demand, but these costs have been impossible to measure adequately. If for some assets they have fallen extremely low—approaching or reaching zero—these assets may actually have become new means of payment.

This suggests the other basic approach to correcting the demand equation: redefine money. The idea is that if the aggregate measures of money can be broadened to include the new as well as the old means of payment, then a standard equation reestimated with the new definitions should be able to more accurately predict money demand without explicitly measuring transaction costs. The effects of the changed transaction costs would simply be cancelled out as the demand for the old money fell and the demand for the new money rose.

There's no doubt that since the mid-1970s the financial system has virtually exploded with new and more attractive ways to hold wealth and make payments. Whereas commercial banks used to be the only institutions which could offer checking accounts, for example, today accounts which can have claims written against them are also available from mutual savings banks and savings and loan associations (NOW accounts), credit unions (share drafts), and money market mutual funds (MMMF shares)—and most of these pay interest. Banks themselves now offer to automatically transfer money from saving accounts into checking accounts so that all the depositor's money bears interest until needed to make a payment (ATS accounts). Banks and savings and loans offer accounts which let depositors order a transfer of funds between savings and checking accounts by a simple telephone call. And these firms have potentially almost eliminated the need for checklike instruments by offering savings accounts from which prearranged bill payments can be made electronically.

These innovations seem to have made it nearly costless to convert some interest-bearing assets into means of payment. The new instruments being used to make payments have thus in effect become money, and the demand for them has increased at the expense of the demand for the traditional measures. To capture the effects of these drastically changed transaction costs in money demand equations and so improve the equations' predictions, economists needed a more up-to-date definition of money.

The Fed's Proposals

So did the Federal Reserve. Early in 1979, the staff of the Fed's Board of Governors published for comment a set of proposed redefinitions of the monetary aggregates (see Simpson 1979).[4] The Fed proposed that besides the traditional currency and demand deposits held by the public at commercial banks, its medium of exchange measure, M-1, also include NOW balances at all depository institutions, share draft accounts at credit unions, demand deposits at thrifts, and ATS accounts at banks. (It also proposed that M-1 exclude demand deposits held by foreign banks and official institutions, since they appeared to be unrelated to economic activity in the United States.)

Other interest-bearing assets affected by recent innovations, the Fed suggested, were still not quite means of payment, but were now easily converted into them and so belonged in its somewhat broader measure of money, M-2. That measure had included old M-1 plus time and savings deposits at commercial banks. The Fed proposed changing this to include proposed M-1 plus just savings deposits, but at all financial firms, not just banks.

However, neither of these proposed definitions seemed to improve the stability of the money demand equation.[5] The Fed staff itself (see Simpson 1979) reestimated the relationships of variables in the standard equation with the proposed definitions and had the equations predict demand in the period 1974:3 through 1978:2—without much better results than with the old definition. Another Fed study, by Porter, Mauskopf, Lindsey, and Berner (1979), got the same sort of results. They conducted an extended statistical investigation of money demand equations with both the old and proposed definitions, including estimating equations and pro-

[4]Improving the performance of the money demand equation was not the only reason for the Fed's redefinitions of money. Because of the recent financial market innovations, the Fed also simply wanted "to bring the monetary aggregates up to date" as economic indicators (see Simpson 1979, p. 14).

[5]Statistical work with the proposed definitions was complicated by the lack of reliable data series on some of the new assets included in them.

jecting demand over different historical periods and formally testing for stability. They concluded that "shifts over time" had characterized demand equations for all money definitions (p. 42).

Because of data problems, the Fed left out of its proposed definitions two financial assets which many thought would improve them as measures of the things people are using as money: shares in money market mutual funds (MMMFs) and repurchase agreements (RPs). MMMFs invest in short-term money market instruments, like Treasury bills, and generally let shareholders redeem shares by letter, by telephone, or by check drawn on the funds. Shares in MMMFs are therefore more attractive than conventional demand deposits for some people. A security RP is usually a very short-term loan made by a large depositor to a financial firm. The firm actually sells a security in its portfolio to the depositor and simultaneously agrees to repurchase it at a specified time and price. RPs' short maturities (frequently only one business day) make them a convenient interest-earning alternative to cash.

Two studies of money demand attempted to show that including one or both of these instruments in the medium of exchange definition of money permits standard empirical demand equations to perform more satisfactorily.

Garcia and Pak (1979) did not clearly succeed. They developed two statistical series which they admit are imperfect estimates of overnight RPs. They added these to the old definition of M-1 to get two revised money stock measures. When they estimated standard demand equations with these measures and had the equations predict 1973–76, they found that in 1974–76 one was not as far off as a standard equation employed to explain old M-1. While Garcia and Pak counted this as a success, they did not present evidence nor claim that they had located stable functions. In fact, they pointed out that their equations did not forecast well in 1973–74.

Wenninger and Sivesind (1979) took a somewhat similar approach, and at first glance they appear to have been more successful. They defined money generally as all checkable assets plus overnight RPs. For a working definition, they started with the Fed's proposed M-1 and added shares in MMMFs, all nonbank RPs at 46 money center banks, and all RPs between government security dealers and nonfinancial corporations. They also added savings deposits held by business firms and state and local governments in order to capture the shift from checking to savings accounts that occurred when savings accounts for these economic units were authorized in 1974–75. With this definition they estimated a demand equation of the standard form and then had the equation predict money demand in the period 1974:3 through 1978:4. In 1974–75, their equation overpredicted demand pretty much as usual. Over the whole period, however, its performance was considerably better than usual. Their equation also passed a formal stability test.

The validity of these results is questionable, though, when they are compared with another recent study's. Porter, Simpson, and Mauskopf (1979) also included MMMF shares and RPs in their definition of money, but unlike Wenninger and Sivesind, they did not produce a stable equation. For the period 1974:3 through 1979:1, their standard equation badly overpredicted money demand. Its cumulative errors mounted very rapidly in 1974–75, matching those of a typical demand equation. In 1976–78 the errors did not grow further, but in 1979:1, the last predicted quarter, they did.

Why the two equations performed so differently might be traced to their slightly different money definitions. Wenninger and Sivesind used proposed M-1, whereas Porter, Simpson, and Mauskopf used old M-1 —yet that shouldn't make a difference here: equations with both M-1s have failed tests of stability. The only other difference between the two is Wenninger and Sivesind's addition of business and government savings deposits as a "shift" component, which the other study omitted. The addition of this component was arbitrary in the sense that the theory does not prescribe it. Since an arbitrary component seems to be what made Wenninger and Sivesind's equation stable, their results are suspect and raise the questions of whether and when and what further special adjustments would have to be made to make the equation keep predicting accurately.

The Fed's New Definitions

The Federal Reserve reviewed the comments it received on the proposed definitions, solved some of its data problems, and in February 1980 announced the official new definitions of money (see Simpson 1980). The Fed decided not to include MMMF shares or RPs in its definition of the medium of exchange. It split M-1 into two measures so that the growth of NOW accounts

could more easily be tracked. The narrowest measure now is M-1A, which equals old M-1 less demand deposits held by foreign commercial banks and official institutions. M-1B equals M-1A plus checkable deposits at all financial firms, which makes it the same as the proposed M-1.

The Fed did decide to include the two controversial assets in its broader definition of money, though. The new M-2, which still attempts to measure the medium of exchange and all its close substitutes, consists of M-1B plus shares in MMMFs, overnight RPs issued by commercial banks, and overnight Eurodollar liabilities issued by Caribbean branches of member banks to U.S. nonbank residents, as well as savings and small time deposits at all depository institutions.

Bennett et al. (1980) tested these new definitions to see if any of them make the equation a better predictor of money demand.

Not surprisingly, the new M-1 definitions don't. These researchers estimated the coefficients of standard demand equations for M-1A and M-1B using data for 1960:4 through 1974:2 and had the equations predict demand in 1974:3 through 1979:4. For M-1A the cumulative overprediction error totaled $62.3 billion, equal to 16.9 percent of the actual level. The M-1B equation did only slightly better; its cumulative error reached $46.9 billion, equal to 12.2 percent of the actual level. Both demand equations failed formal tests of stability.

Bennett et al. also evaluated the new M-2 definition, but using a standard equation in a slightly different form. In it money demand as a proportion of nominal household net worth is a function of the ratio of GNP to net worth, three short-term interest rates, and the lagged value of the money-wealth ratio. They estimated this equation on the same initial data period and had it predict the same period as the M-1 equations. The results were mixed. In the first part of the period it overpredicted; then in the last part it underpredicted. By the final quarter the underprediction totaled $29.4 billion, equal to 1.9 percent of the actual value.

This is a relatively good performance, but not an undisputable one. It appears to have occurred because the coefficient on the lagged money-wealth ratio is 0.996, while other coefficients are either small (on the bill and passbook rates) or small and insignificant (on the ratio of GNP to net worth and the time deposit rate). The size of the coefficient on the lagged variable implies unrealistically that people react to a discrepancy between their desired and actual asset holdings at a microscopic pace. Considering the smallness of the other coefficients, it also implies that the lagged values dominate the demand equation. In short, this is at best an unorthodox money demand equation. And more damaging, it failed formal tests for structural stability.

Why the Search is Failing

So, neither redefining money nor revising the determinants of money demand has improved the ability of the standard macroeconomic equation to predict the public's demand for money. What more can be done? Not much, according to economic theory. Theory suggests that the equation has been failing and will likely continue to fail for quite a while because it does not adequately model the way individuals decide how much money to hold.

We have already noted one way this is true: the equation does not include a measure of transaction costs, which the one-period theory behind the equation considers an important determinant of money demand. Redefining money was an attempt to get around that requirement, but as we have seen, it did not work. A closer look at the theory reveals why.

When transaction costs change sharply, the demand for different definitions of money is not all that is affected. Individuals do decide to hold their wealth in different ways, but other decisions are affected too—especially how much they will spend in any period. Impulse buying is likely to increase, for example, when wealth kept in interest-bearing accounts becomes easier to spend: people can write "checks" on those accounts immediately instead of first making a trip to the bank.

That changes in transaction costs change spending as well as the allocation of wealth among financial assets means, of course, that they also change the relationship between spending and money holdings, however money is defined. Thus, in an aggregate money demand equation, the coefficient of the spending variable will change with transaction costs; in an unstable financial environment, the equation will not be stable. Regardless of which assets are counted as money, then, unless transaction costs are actually in the equation to catch their own sharp changes, the equation can only be a very poor predictor of money demand.

This helps explain why the standard equation has been failing badly since the mid-1970s. Because of the difficulty of measuring transaction costs, the equation has not included them at a time when the introduction of new financial instruments has sharply changed those costs and spending and the demand for money. Further, this suggests that the standard equation won't be stable soon, for the financial industry seems likely to continue to change rapidly for some time.

Computer-communications technology which lowers the costs of cashing in assets has begun to be adapted to this industry, most prominently in automatic tellers, cash machines, and electronic payroll depositing. Wider use of this kind of technology seems inevitable, and it will be encouraged by a new regulatory environment. The government has begun to loosen its restraints on the financial industry, allowing NOW accounts to be offered nationwide in 1981, for example, and beginning to phase out interest rate ceilings on savings accounts. With more freedom to compete, firms will undoubtedly introduce cost-cutting technologies as well as new financial assets that fill gaps in the existing spectrum. That will surely affect the costs people face when they decide how to hold their wealth, the amount of spending they want to do, and ultimately their demand for money. An aggregate demand equation without explicit measures of transaction costs will thus still be unreliable.

Even if transaction costs could be measured or should stabilize, though, the macro money demand equation would still fail as a policymaking predictor for the Federal Reserve. For as Lucas (1976) has demonstrated, this type of equation is inadequate in a much more fundamental way: the theory behind it—and so the equation—does not acknowledge that individual decision making involves looking ahead.

The theory behind the standard equation, remember, does not mention expectations of anything as an important determinant of money demand in a given period. Yet individuals trying to do the best they can for themselves will not limit themselves to considering just their current situation. Rather, how much spending they will do in any period and how much money they will hold to finance that spending will depend crucially on what they expect such factors as income, prices, interest rates, and transaction costs to be in the future.

Some researchers working with the standard equation appear to have recognized this inadequacy in the theory and, since expectations are so hard to measure, have tried to make up for it by tacking on things like the lagged money stock and the ratchet interest rate variable. But for predicting the effects of alternative monetary policies the tack-on technique is not good enough because it misses the interrelationships between individuals' expectations, their spending and money holding decisions, and government policies.

What people expect things like prices, rates, and costs to be in any future period depends critically on what government policies will be. If future policies are going to be the same as in the past, then people will use the historical relationships they have observed among economic variables to help predict these variables. If future policies are going to be different, however, then people will stop relying on historical relationships to help them make predictions, or at least they will use history differently.

Consider, for example, what would happen if the Federal Reserve announced a new, very simple policy of aiming to fix the federal funds rate at 1 percent. This obviously would be quite a change from past policies and would make past economic relationships obsolete as forecasters. People trying to do the best they can for themselves would recognize that and devise some better way to form expectations of anything related to the funds rate, particularly prices and interest rates on nonmoney assets.

Changes in expectations such as these bring changes in people's decisions about how much spending to do and how to allocate their wealth. So, as government policies change, the relationships between money demand and its determinants will change as well; these historical relationships will be obsolete too.[6]

This means, of course, that the coefficients representing those relationships in an aggregate money demand equation will keep changing with government policies. For the purposes of policy evaluation, in other words, the search for a stable money demand equation is futile.

Conclusion

As a predictor of money demand under current government policies, the aggregate equation need not be discarded. Someday it may be reliable—if the financial

[6]For a technical elaboration of this argument, see the article by Thomas J. Sargent in this *Quarterly Review* and Lucas and Sargent 1979.

industry and transaction costs settle down or if someone devises a way to adequately measure and represent transaction costs. Until then anyone using an aggregate equation to forecast under current policies must recognize that their errors will continue to be large and perhaps will be even larger than in the past.

If the Fed and other policymakers want models to help them choose the best economic policies, though, the Lucas critique suggests that they should abandon the current macroeconomic approach. Since changes in government policies have such far-reaching effects on individual decision making, policymakers should turn to models which explicitly take this into account.[7]

[7]For a technical description of such models, see the article by Thomas J. Sargent in this *Quarterly Review*.

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