Measuring the Nearness of Modern Near-monies: Evidence from the Early 1980's

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Disciplines
Business Administration, Management, and Operations | Economic Theory | Finance | Other Public Affairs, Public Policy and Public Administration

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Measuring the Nearness of Modern Near-monies: Evidence from the Early 1980's

by Jean A. Gauger and John R. Schroeter*

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Abstract

Existing empirical studies of the degree of substitutability among various monetary assets generally ignore several financial instruments which only recently have become prominent. Here this deficiency is remedied by investigating substitution behavior within a portfolio of near-monies which includes money market funds and interest bearing checkable deposits, as well as conventional savings and time deposits. The research uses a standard technique of empirical production studies that has recently been applied to the issue of monetary asset substitution by Sims, Takayama, and Chao (1987). The findings here provide evidence of significant substitutability between each of the "modern" near-monies examined and money narrowly defined.
1. Introduction

The Federal Reserve's effectiveness in achieving policy objectives through manipulation of specific monetary aggregates is limited by the public's ability to substitute alternative assets for targeted assets, and thus mitigate the impact of Fed policy actions. This limitation of Fed policy has been particularly acute in the years since the proliferation of alternative financial instruments in the mid-1970's. Consequently, there currently is renewed interest in the question first investigated by Chetty (1969) and further examined by Boughton (1981) and Husted and Rush (1984): To what extent can various financial assets substitute in agents' portfolios for conventional, narrowly defined monetary aggregates? In spite of the current relevance of this issue, the majority of existing empirical assessments of substitutability among assets use sample periods that predate the active financial innovation of the 1970's or omit from the analyses several financial assets that have recently come into widespread use.

Ewis and Fisher (1984); Serletis and Robb (1986); and Sims, Takayama, and Chao (1987) have developed empirical models which allow assessment of the substitutability or complementarity among several assets jointly. The models use duality theory results to derive systems of asset demand equations from translog specifications of an agent's indirect utility or money service cost function. In this paper, we apply the Sims, Takayama and Chao production theory approach to very recent monthly data on holdings of currency and demand deposits, conventional savings, small time deposits, and two financial instruments that have become prominent in the late 1970's and early 1980's: money market funds and interest bearing checkable deposits. Briefly, our
results provide evidence of significant substitutability between each of the "modern" assets and currency and demand deposits.

The next section of this paper outlines the theoretical development underlying the empirical model. Section three discusses the estimation procedure to be applied while section four describes the data to be used. Section five presents our results and relates them to findings reported in the literature while a concluding section provides a brief summary.

2. Theoretical Foundations

The use of systems of factor cost share equations, derived from flexible form cost functions, to assess the degree of substitutability or complementarity among inputs is a conventional technique in production studies. Berndt and Wood (1975) provide an example of this approach and a concise summary can be found in Takayama (1985). We follow Miles (1978), Sims and Takayama (1980), and Sims, Takayama, and Chao (1987) in applying this technique to the estimation of the potential for substitution among monetary assets. The remainder of this section briefly outlines the theoretical basis for this approach.

A representative agent uses quantities $M_1, M_2, \ldots, M_n$ of $n$ "money" assets to produce a quantity $Y$ of "money services." For any given level of money services, the cost minimizing levels of the assets are specified by the set of $n$ conditional factor demand functions denoted

$$M_i = M_i (p_1, p_2, \ldots, p_n, Y, \tau) \quad \text{for } i = 1, 2, \ldots, n, \quad (1)$$

where $p_i$ is the opportunity cost of holding one unit of money asset $i$ for one period, $\tau$ is a proxy summarizing technological and institutional
change (hereafter, "technological change"), and additional features of the production technology are subsumed in the forms of the $M_1(\cdot)$ functions.

The cost function is given by

$$C = p_1 M_1 + p_2 M_2 + \cdots + p_n M_n,$$

which, in view of (1), can be written as

$$C = C(p_1, p_2, \ldots, p_n, Y, \tau). \quad (2)$$

Instead of deriving equations (1) and (2) via constrained minimization given a specific form for the production function, it is more convenient to use the dual approach of specifying a form for the cost function directly. Following Sims, Takayama, and Chao (1987), we adopt the translog functional form which has been shown to be sufficiently flexible as to provide a second order approximation for any well-behaved cost function.\(^2\) Thus, let the cost function be implicitly defined by

$$\log C = \sum_{i=1}^{n} \alpha_i \log p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \alpha_{ij} \log p_i \log p_j$$

$$+ \sum_{i=1}^{n} \beta_{iY} \log p_i \log Y + \sum_{i=1}^{n} \gamma_{i\tau} \log p_i \log \tau, \quad (3)$$

where, without loss of generality, one can take $\alpha_{ij} = \alpha_{ji}$ for $i, j = 1, 2, \ldots, n$. Among the necessary and sufficient properties of cost functions is linear homogeneity in factor prices. This requires

$$\sum_{i=1}^{n} \alpha_i = 1, \quad \sum_{i=1}^{n} \beta_{iY} = 0, \quad \sum_{i=1}^{n} \gamma_{i\tau} = 0, \quad \text{and} \sum_{j=1}^{n} \alpha_{ij} = 0 \text{ for } 1, 2, \ldots, n. \quad (4)$$
Shephard's lemma establishes the relationship between the conditional factor demands, (1), and the cost function, (2), as

\[
M_i = \frac{\partial C}{\partial p_i} \quad i = 1, 2, \ldots, n.
\]

Differentiating equation (3) and expressing the input demands in cost share form, one obtains

\[
\theta_i = \alpha_i + \sum_{j=1}^{n} \alpha_{ij} \log p_j + \beta_i \gamma \log Y + \gamma_{it} \log \tau
\]

for \( i = 1, 2, \ldots, n \)

where \( \theta_i = p_i M_i / C \) is the share of total cost attributable to the \( i \)th input asset. The Allen partial elasticities of factor substitution are defined by

\[
\sigma_{ij} = \eta_{ij} / \theta_j \quad \text{for} \ i, j = 1, 2, \ldots, n,
\]

where \( \eta_{ij} = (\partial M_i / \partial p_j) p_j / M_i \) is the elasticity of the conditional demand for the \( i \)th input with respect to the \( j \)th factor price. Given our specification, it is straightforward to show that

\[
\sigma_{ii} = (\alpha_{ii} + \theta_i^2 - \theta_i) / \theta_i^2 \quad \text{for} \ i = 1, 2, \ldots, n
\]

and \( \sigma_{ij} = (\alpha_{ij} + \theta_i \theta_j) / \theta_i \theta_j \quad \text{for} \ i \neq j = 1, 2, \ldots, n. \)

Inputs \( i \) and \( j \) are Hicks-Allen substitutes (complements) if \( \sigma_{ij} > 0 \) \((\sigma_{ij} < 0)\).
3. **Estimation Procedures**

From (6), it is clear that the system of equations given by (5) can be used as a basis for estimation of the elasticities of substitution between pairs of monetary assets in an arbitrary n-asset portfolio. Rewrite these equations, augmented with additive disturbance terms and "t" subscripts to identify observations in the sample, as follows:

\[
\Theta_{it} = \alpha_i + \sum_{j=1}^{n} \alpha_{ij} \log p_{jt} + \beta_{iy} \log Y_t + \gamma_{it} \log \tau_t + \varepsilon_{it} \tag{7}
\]

for \( i = 1, 2, \ldots n \)

and \( t = 1, 2, \ldots T \).

Although based on an optimization problem for a "representative" individual, the model will be estimated using economy-wide aggregate values for factor costs shares and the output of monetary services. For this aggregation to be valid, it is sufficient that the money service production technology be homothetic, meaning that factor cost shares are independent of scale. This can be tested by investigating whether \( \beta_{iy} = 0 \) for \( i = 1, 2, \ldots n \). Measurement of the output of money services and the technology variable pose obvious problems. Nominal personal income is adopted as a proxy for the quantity of money services \( Y \) and a simple time trend serves as a proxy for technological and institutional change \( \tau \). A number of formulations have been proposed for the \( p_{jt} \)'s, the opportunity costs of holding the assets in the portfolio. We use the approach of Sims, Takayama and Chao (1987), and others in which \( p_{jt} \) is taken to be \((1 + r_{jt})^{-1}\) where \( r_{jt} \) is the \( j^{th} \) asset's own rate of return in period \( t \).
The properties of the error terms in equations (7) will dictate estimation strategies. In this case there are three aspects to be considered: contemporaneous correlation across equations, serial correlation, and correlation between the \( \varepsilon_{it} \)'s and the regressors.

Since the \( \Theta_{it} \)'s are factor cost shares, they must sum to one for each date. This feature, together with the symmetry and homogeneity conditions, implies \( \sum_{i=1}^{n} \varepsilon_{it} = 0 \) for all \( t \). Thus the covariance matrix of contemporaneous errors is singular. The usual method of dealing with this problem involves dropping one of the factor cost share equations and estimating the system of \( n-1 \) remaining equations using a procedure, like Zellner's seemingly unrelated regression technique, which accounts for across-equation error correlations. The parameters of the "dropped" equation can then be inferred from those of the estimated system using the symmetry and homogeneity conditions. The homogeneity conditions also impose within equation restrictions on the \( a_{ij} \)'s which must be maintained in estimation.

Serial correlation of the \( \varepsilon_{it} \)'s must be handled separately. Here we assume that each equation's error term follows a first order autoregressive process

\[
\varepsilon_{it} = \rho \varepsilon_{it-1} + u_{it} \quad \text{for } i = 1, 2, \ldots n
\]

and \( t = 2, 3, \ldots T \),

where \( \rho \) is an unknown parameter and the \( u_{it} \)'s are serially uncorrelated random variables. As Berndt and Savin (1975) have shown, the "adding up" constraint to which the \( \varepsilon_{it} \)'s are subject imposes the restriction that all of the first-order autoregressive coefficients be equal. The procedure we apply involves a first stage estimation of the system, recovery of the
residuals and computation of the usual OLS estimate of \( \rho \), and a second, and final stage estimation of the model in quasi-first-difference form.

Finally, since asset quantities and opportunity costs, or interest rates, presumably satisfy market supply or regulatory relations as well as demand relations, it is natural to think of the \( \Theta_{it} \)'s and \( p_{jt} \)'s as being simultaneously determined by a larger model of which equations (7) are parts. While specification of such a complete model is beyond the scope of this paper, the jointly endogenous nature of the \( \Theta_{it} \)'s and \( p_{jt} \)'s does have implications for estimation strategies. Since the error terms are likely to be correlated with the \( p_{jt} \)'s we apply an instrumental variables version of Zellner's seemingly unrelated technique, iterated three-stage least squares. This procedure obtains estimates of the parameters of the system by minimizing a generalized sum of squares defined by

\[
\hat{\epsilon}'( \Sigma^{-1} \times W ) \hat{\epsilon}/T, \tag{8}
\]

where \( \hat{\epsilon} \) is a \( Tn \times 1 \) vector of the residuals for the \( n \) equations stacked together; \( \hat{\Sigma} \) is an estimate of the covariance matrix of contemporaneous errors computed iteratively from the residuals; \( W = Z(Z'Z)^{-1}Z' \), where \( Z \) is a \( T \times k \) matrix of instruments; and \(*\) is the notation for the Kronecker product. The asymptotic properties of the estimator are established by Gallant (1977). Gallant and Jorgenson (1979) provide a test statistic, based on the optimization criterion, which can be used to test sets of restrictions on the unknown parameters.5

4. Data

Monthly data on quantities and associated interest rates for a variety of financial assets were obtained from the Federal Reserve Board
of Governors. The data include a number of financial assets not available in published sources. The portfolio examined here consists of five composite assets:  

1) Currency plus demand deposits (household, business, and other); 2) "Other checkable deposits" (including supernows) at commercial banks and thrifts; 3) Savings at commercial banks, savings and loans (S&L's), credit unions, and mutual savings banks (MSB's); 4) Small time deposits at commercial banks, savings and loans, credit unions, and mutual savings banks; and 5) Non-institutional and institutional money market funds.

"Other checkable deposits" include negotiable order of withdrawal (NOW) accounts, credit union share drafts, and automatic transfers from savings (ATS) accounts with depository institutions. NOW accounts were developed in New England in the early 1970's, but did not spread nationwide until allowed in 1980 by the Depository Institutions Deregulation and Monetary Control Act. NOW accounts and credit union share drafts are essentially checking accounts that pay interest.

"Small" time deposits are non-negotiable time deposits with denominations of less than $100,000. Money market funds, which were developed during the 1970's, allow individuals with small amounts to invest to participate in the purchase of money market instruments, which typically are in denominations too large for most individual investors. Money market fund assets are invested in large certificates of deposit, security repurchase agreements, commercial paper, U.S. government securities, and so forth. Thus, they typically offer higher returns than savings accounts. An individual may write checks against the balance in a money market account, although the minimum allowable denomination typically is large (for example, $500).
Interest rates on the five composite assets are computed as quantity weighted averages of the yields on component assets. Following procedures used elsewhere (Sims, Takayama, and Chao (1987); Chetty (1969) and others), the interest rate on currency and household demand deposits is zero. The rate on business demand deposits is an imputation provided by the Federal Reserve Board of Governors. Regulation Q ceiling rates, phased out in 1986, prevailed for other checkable deposits and savings at commercial banks, S&L's, credit unions, and MSB's.

The time frame of analysis, January, 1979 to August, 1986, is more recent than is used in most existing studies. This time frame captures the active financial innovation of the 1970's and 1980's in the examination of substitutability of near monies.

5. Results and Interpretation

The procedures described in Section 3 were applied to monthly data for the time period and portfolio described in Section 4. Table 1 contains estimates and asymptotic standard errors for the parameters of equations (7) and $\rho$, the first order autoregressive coefficient of the error processes. The parameters of the cost share equations for the first four assets were estimated directly; the parameters of the money market funds equation can be inferred from these. The table also contains conventional $R^2$ statistics for the model's equations in quasi-first-difference form. The Gallant-Jorgenson statistic, which is relevant to a test of homotheticity of the production technology, is asymptotically $\chi^2$ with four degrees of freedom. Its value (9.3977) indicates that homotheticity cannot be rejected at the 5% significance level. The
strongly significant estimate of $\rho$ is an indication of the appropriateness of the correction for autoregressive errors.

The estimates of the $\gamma_{it}$'s have implications about the manner in which the technology of money service production has changed over time. For a given level of money services and constant relative asset costs, the optimal holdings of conventional savings have fallen, during the 1979-86 period, while optimal holdings of money market funds have risen. This may be a consequence of the advent and proliferation of the use of computers in portfolio management. This advance in transactions technology has facilitated agents' abilities to transfer wealth in and out of low return, high security assets, such as savings accounts, as market opportunities dictate. Thus, lower average balances are possible in such "safety net" accounts and higher average holdings of more volatile assets are permitted, as the significant $\gamma_{it}$'s indicate.

Primary interest lies in the implications of these estimates for the elasticities of substitution between asset pairs. The matrix in Table 2 contains estimates of these elasticities, and their asymptotic standard errors, computed using equations (6) with the $\Theta_i$'s set at their sample mean values. Off-diagonal elements are elasticities of substitution while the diagonal elements are own-price elasticities of the conditional factor demands. Theory predicts that these be negative. All point estimates of own-price elasticities are negative with three being significant at conventional levels. It is interesting to note the high own-price elasticity for other checkable deposits ($\eta_{22} = -3.841$) relative to $\eta_{ii}$'s for other assets, particularly the own-price elasticity for conventional checking deposits ($\eta_{11} = -.052$).
Turning to the major theme of this research, the \( \sigma_{ij} \) elasticities of substitution, results for each asset will be discussed in turn. Currency plus demand deposits showed significant substitutability with other checkable deposits and money market funds; that is, with both of the "modern" assets examined in this study. The stronger substitution possibility occurred between OCD's and demand deposits \( (\sigma_{12} = 2.268) \). This result differs from Serletis and Robb's (1986) finding of no significant substitutability between OCD's and demand deposits in their study using Canadian financial data. Note that elasticity results in many previous studies (for example, Chetty (1969); Boughton (1981); Husted and Rush (1984); Ewis and Fisher (1984); Sims, Takayama, and Chao (1987); and others) are based upon asset sets generally consisting of old M1 (currency plus demand deposits, asset 1 in this study), and savings accounts and time deposits at various types of financial institutions. Some of the studies find low substitutability between currency plus demand deposits and the other financial assets, and therefore conclude that old M1 is a "unique" asset. However, these studies omit from the analysis other checkable deposits which are found here to be significant substitutes with currency and demand deposits. For studies using pre-1970 data (Chetty (1969), for example) the omission is appropriate and unlikely to alter conclusions; OCD's were not widely used at that time, and several types of OCD's did not yet exist. For more recent studies, however, the omission of OCD's from the asset set may exaggerate the apparent uniqueness of narrowly defined money.

In addition to currency plus demand deposits, other checkable deposits showed significant substitutability with savings deposits. In fact, this was the largest elasticity of substitution \( (\sigma_{23} = 14.24) \)
occurring in this portfolio. There has been considerable speculation about whether funds placed in OCD's should be regarded primarily as liquid "transactions funds," or as "savings funds." Here, OCD's are found to substitute with both demand and savings deposits. However, the elasticity of substitution with savings deposits is found to be higher. In general, other checkable deposits showed higher price responsiveness than other assets. The own-price elasticity and elasticities of substitution of OCD's with demand deposits and savings deposits ($\sigma_{12}$ and $\sigma_{23}$) were the largest elasticities occurring in the portfolio. It appears that OCD funds are managed more aggressively than other assets.

Along with the substitutability with OCD's, savings accounts also showed significant substitution possibilities with money market funds, and significant but lower substitution possibilities with small time deposits. Small time deposits are not readily substitutable with other assets in the portfolio. The only significant elasticity of substitution was with savings, $\sigma_{34}$, but it is not of very large magnitude.

Money market funds showed the strongest substitution potential with savings ($\sigma_{35}$), followed by demand deposits ($\sigma_{15}$, marginally significant). Recall that, while checks can be written on MMF accounts, they are restricted to large minimum amounts. As a result, MMF accounts are used infrequently for transactions purposes and serve more as liquid savings type assets, as the $\sigma_{35} > \sigma_{15}$ result indicates.

Two significant complement pairs were found: currency plus demand deposits and savings accounts ($\sigma_{13}$), and small time deposits and money market funds ($\sigma_{45}$). Sims, Takayama, and Chao (1987) and Ewis and Fisher (1984) also find some evidence of complementarity between currency plus demand deposits and a savings asset at commercial banks. This may be
related, in some way, to the fact that checking accounts at commercial banks and conventional passbook savings accounts both tend to be held by the same type of people; people of modest wealth who are relatively unsophisticated in financial matters.

A comparison of the results of Chetty (1969), Boughton (1981), and Husted and Rush (1984) reveals that seemingly minor differences in model formulation, estimation technique, and the measurement of variables can produce tremendous variation in the magnitudes of estimated elasticities of substitution among monetary assets. Care must be taken, therefore, in comparing numerical results across studies. Our model is identical and our estimation procedures are quite similar to those of Sims, Takayama, and Chao (1987), yet our estimates of substitution elasticities are generally smaller than theirs. This can be explained by considering differences in assets entering the respective portfolios. Sims, Takayama and Chao treat accounts at different financial institutions as separate assets; savings at commercial banks, S&L savings accounts, and MSB savings deposits all enter the portfolio separately. Here, assets of a given type (e.g., all savings assets) are grouped into a single composite asset. Barnett (1980) evaluates substitution behavior across financial institutions for a given asset type versus substitution behavior across asset types. He finds higher elasticities of substitution across institutions for a given asset type than occur across the asset types. The high elasticities found in Sims, Takayama and Chao and other previous studies may largely represent the substitution across institutions for a given asset type, while elasticities here capture the substitution possibilities between the asset types.
6. **Summary**

The Fed's effectiveness in influencing economic activity is limited by the public's ability to circumvent changes in the levels of monetary aggregates through adjustments of holdings of comparable, alternative assets. Consequently, the degree of substitutability among financial instruments is particularly relevant to policy questions in the wake of the rapid financial innovation of the mid-1970's. Using a conventional empirical technique and very recent data on interest rates and asset holdings, we have measured elasticities of substitution within a portfolio of five composite assets. Our findings indicate that the two "modern" assets in the portfolio, money market funds and interest bearing checkable deposits, are significant substitutes for currency and demand deposits at commercial banks. In addition, holdings of interest bearing checking deposits showed greater own- and cross-price elasticities than the other assets, suggesting that the users of these accounts are highly responsive to changes in market conditions.
Table 1

IT3SLS Estimates of the System of Factor Cost Share Equations\(^a\)

\[ \Theta_{it} = \alpha_i + \sum_{j=1}^{n} \alpha_{ij} \log p_{jt} + \beta_{1Y} \log Y_t + \gamma_{1\tau} \log \tau_t + \varepsilon_{it} \]

(Sample = January 1979 - August 1986)

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\(^a\)The asset set is as follows: asset 1 = currency + demand deposits, asset 2 = other checkable deposits, asset 3 = savings, asset 4 = small time deposits, asset 5 = money market funds. The table contains directly estimated parameters only. Point estimates of others can be inferred using the homogeneity conditions (4). Instruments included a constant, the time trend, current and lagged nominal personal income and lagged interest rates.

\(^b\)Gallant-Jorgenson statistic for test of homotheticity (H : \(\beta_{1Y} = \beta_{2Y} = \beta_{3Y} = \beta_{4Y} = 0\)) was 9.398; asymptotically \(\chi^2\) with 4 degrees of freedom.

\(^c\)\(R^2\)'s are for the equations of the model in quasi-first-difference form.
Table 2

Estimates of Elasticities of Substitution and Own Price Elasticities of Conditional Factor Demands$^a$

(Sample = January 1979 - August 1986)

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$^a$The asset set is as follows: asset 1 = currency + demand deposits, asset 2 = other checkable deposits, asset 3 = savings, asset 4 = small time deposits, asset 5 = money market funds. The i-j off-diagonal element is the elasticity of substitution between assets i and j. The diagonal element is the own-price elasticity of the conditional factor demand for asset i. Asymptotic standard errors are in parentheses.
Notes

1 Hester (1981) and Wenninger (1984) provide general discussions of the problems that financial innovation poses for monetary policy.

2 This property of the translog form is made precise and proved in Dievert (1974).

3 Ewis and Fisher (1984) and Serletis and Robb (1986) derive the asset demand equation using a utility maximization, rather than cost minimization, approach. The essential difference between the two methods is that the production theory procedure produces a system of conditional factor (compensated) demand functions, which are subject to symmetry restrictions, while the utility theory procedure used by Ewis and Fisher and Serletis and Robb produces a system of Marshallian demand functions.

4 This is the formulation originally used by Chetty (1969) and adopted by Sims, Takayama, and Chao (1987). It assumes that the output of money services is derived from end-of-period asset levels which are chosen to minimize the beginning-of-period (or present value of) portfolio costs. As Boughton (1981) has pointed out, the choice of a time interval for measuring an asset's rate of return is somewhat arbitrary. Since we use annual interest rates, our estimated elasticities should be interpreted as pertaining to a horizon of one year.

Other measures of the opportunity cost of holding an asset include Boughton's (1981), \( (1 + r_{mt}^t)/(1 + r_{jt}^t) \) where \( r_{mt} \) is Startz' (1979) implicit yield on money. Husted and Rush (1984), basing their formulation on a dynamic model of the consumer's portfolio choice problem, used \( (d_t^t - r_{jt}^t)/d_t^t \) where \( d_t \), the discount rate, was proxied by the yield on long term corporate bonds. Ewis and Fisher (1984) and Serletis and Robb (1986) used a formula derived by Barnett (1978), \( (R_t^t - r_{jt}^t)/(1 + R_t^t) \) where \( R_t \) is a "benchmark" interest rate taken to be the highest observed rate for the period. Naturally, all of these measures of the cost of holding the asset are inversely related to the asset's own interest rate. See Sims, Takayama, and Chao for further discussion of the technological change, money services and opportunity cost variables.

5 The statistic is simply \( T \) times the difference between the minimized generalized sums of squares (given by expression (8)), for the restricted and unrestricted models, computed with \( T \) constrained to be the same matrix in the two cases. It is asymptotically \( \chi^2 \) with \( k \) degrees of freedom where \( k \) is the number of restrictions.

6 Specifically, asset 1 is currency plus travelers' checks plus demand deposits held by households, businesses and others; asset 2 is "other checkable deposits" (including supernows) at commercial banks and thrifts; asset 3 is savings less money market deposit accounts at
commercial banks, S&L's, credit unions, and MSB's; asset 4 is small time deposits including retail repurchase agreements less IRA/Keogh deposits at commercial banks, S&L's, credit unions, and MSB's; asset 5 is non-institutional and institutional money market funds (tax exempt and non-exempt) less IRA/Keogh deposits at money market funds. 

Note that many previous studies (Sims, Takayama, and Chao (1987) and others) treat similar accounts at different financial institutions (e.g., savings at S&L's, savings at MSB's) as separate assets. Here, they are grouped into a single composite asset. This has consequences for the magnitude of estimated elasticities, as is discussed below. Furthermore, it implies the asset coverage here is much broader than asset sets elsewhere in which, perhaps, three of the five assets represent a "savings type" account at different financial institutions.

7 Mutual savings banks are savings institutions authorized in only a few states, a fact which has severely restricted their growth. There are only about 400 MSB's operating, primarily in the Northeast and Mid-Atlantic states.

8 The translog cost function is positive and linearly homogeneous by construction. The estimated function is increasing in each factor price at every sample point, but fails to be concave at several of the sample points and at sample means. Matrices of substitution elasticities typically had negative diagonals but one positive eigenvalue.

9 The estimate of $\gamma_3$ is significantly negative. Using the homogeneity conditions, the implied estimate of $\gamma_5$ is found to be 0.2486 with an asymptotic standard error of 0.0702.

10 With this line of reasoning as a basis, one might have also anticipated a significantly negative value for the estimate of $\gamma_1$.

11 The sample mean costs shares are as follows; currency plus demand deposits, 34.6%; other checkable deposits, 5.8%; savings, 24.0%; small time deposits, 29.2%; and money market funds, 6.3%. The asymptotic standard errors were computed treating the mean cost shares as nonrandom.

12 Regulation Q prohibited payment of interest on conventional demand deposits. As people became more familiar with other checkable deposits, it is possible that those who were highly price responsive moved funds over to OCD's. Those who continued to hold demand deposits were the less price responsive individuals and businesses which were not allowed to hold many types of the OCD accounts.

13 Ewis and Fisher also include short-term Treasury securities and a foreign asset in their portfolio.

14 One possible explanation for this may relate to historical aspects of OCD development. Since OCD's originated at non-bank financial institutions, which traditionally offered savings assets, people regard funds placed there primarily as savings rather than transaction balances. It took a while for the general public to accept the check writing features of OCD's as comparable to those of commercial bank demand deposits.
References


Startz, R. "Implicit Interest on Demand Deposits." *Journal of Monetary Economics* 5 (1979), 515-34.
