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THE CHANGING EMPIRICAL DEFINITION OF MONEY: SOME ESTIMATES FROM A MODEL OF THE DEMAND FOR MONEY SUBSTITUTES

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I. INTRODUCTION

The effects of financial innovations have dominated discussions about the implementation of monetary policy since 1981. The nationwide introduction of NOW accounts that year, supplemented by MMDAs in December 1982 and Super NOWs in January 1983, raised a variety of questions concerning which monetary aggregate should be targeted, whether the new accounts were responsible for slower observed velocity growth in 1982-86 and whether the historical link between M1 and GNP has been broken. In short, the question is whether these new accounts possess characteristics of "money" and should be treated as such in the conduct of monetary policy.

The empirical evidence on this question comes primarily from estimates of reduced-form GNP equations or money demand equations based on *ad hoc* adjustments to official measures of the money stock. These studies, however, have not dealt with the more recent introduction of MMDAs and Super NOWs. Moreover, while the voluminous work of Barnett and his colleagues on Divisia monetary aggregates offers strong theoretical and empirical criticism of the simple-sum weighting scheme used to construct the official monetary aggregates, it has not yet considered the question of which financial assets can be grouped into a collection that represents "money."

Stated differently, deciding on the collection of assets to be included in a superlative index of the money stock is at least as important as determining asset weights. This question, however, has received little attention.

This paper offers empirical evidence on the "moneyness" of the new interest-bearing checking accounts and how they have affected the operational definition of M1. Our analysis is based on Barnett's admissibility criterion of aggregation theory, which states that a collection of commodities is a candidate for an aggregate good if that collection is weakly separable from other arguments in the representative utility function.[1/] Thus, for example, if the current definition of M1 is to meet the admissibility criterion, it must be shown that currency, demand deposits, NOWs and Super NOWs represent a block of commodities that is weakly separable from other financial assets.

In this paper, we test the weak separability of M1 and other plausible asset collections by using nonparametric demand analysis (Varian; Diewert and Parken) for the components of M1 plus MMDAs, Money Market Mutual Funds (MMMFs) and savings deposits. Using a sample of monthly data for May 1983-August 1985, we find evidence to support the notion that M1A (M1 minus other checkable deposits) and the current definition of M1 both satisfy the admissibility criterion of aggregation theory. Subsequent tests, however, indicate that the more narrow definition of money performs better as an intermediate target variable.

The remainder of the paper proceeds as follows. We first review discussions of how financial innovations are perceived to have affected the implementation of monetary policy and previous studies that have attempted to make the distinction between money and near monies. Section IV outlines the basis for testing for weak separability between alternative asset collections and reports the results of these tests. Having established which monetary aggregates pass the admissibility criterion, Section V compares the performance of these aggregates within the context of a St. Louis equation. The alternatives also are assessed in terms of their controllability. Section VI presents the conclusions.

II. FINANCIAL INNOVATIONS AND THE CONDUCT OF MONETARY POLICY

That uncertainty about the effects of financial innovations on measured money growth dominated policy discussions in 1983 can be seen from a casual look at the record of the Federal Open Market Committee (FOMC). The record of the FOMC meeting held February 8-9, 1983, states, for example:

> "Committee members' views varied considerably on the weight to attach to M1 ... the performance of that aggregate had been subject over the past year or more to substantial uncertainties related to the growing role of NOW accounts and an apparent shift in the behavior of its income velocity ... Only modest allowance was made for the possibility that the new Super NOW accounts would draw funds into M1 from other sources."

[<u>Bulletin</u>, April 1983, pp. 288-89]

Two months later, in a statement to Congress, Chairman Volcker reported:

> "To some extent--but it cannot be measured with any degree of certainty--the decreases in "velocity" may reflect the changing nature of M1; with interest-bearing NOW and Super NOW accounts making up an increasingly large proportion of M1, this aggregate may be influenced by "savings" behavior as well as "transactions" motives. That is a longer-term factor, and the growth in M1 over the shorter-run may have been affected by the reduced level of market rates--particularly relative to interest-bearing NOW accounts--and slowing inflation as well. The range of uncertainty on these points is substantial (emphasis added) and has led the Federal Open Market Committee to place less emphasis on M1 in the implementation of policy over the short term."
>
> [Bulletin, May 1983, p. 338]

Clearly, these and other official statements indicate that considerable uncertainty has existed concerning how interest-bearing checking accounts are being used and how their use might affect the behavior of the monetary aggregates generally and the behavior of M1 velocity specifically.

III. INTEREST-BEARING CHECKABLE DEPOSITS AS MONEY SUBSTITUTES: THE CURRENT EVIDENCE

The existing work on the moneyness of different assets and the effects of financial innovations follows three distinct paths. Much of this work, however, predates the introduction of NOW accounts and other interest-bearing checkable deposits.

Using pre-1980 data, Barnett (1980), Offenbacher (1979, 1980) and Ewis and Fisher (1984a, b) apply consumer demand theory to estimate elasticities of substitution between M1A and other assets, such as savings balances. The general conclusion of this work is that few assets appear to be good substitutes for money, but the sample considered does not include any of the financial innovations. While this consensus differs from Chetty's (1969) finding that many assets were close substitutes for money, Boughton (1981) and Husted and Rush (1984) correct errors in Chetty's analysis and report low substitutability between money and other assets.

Generally speaking, these studies provide support for a narrow monetary aggregate and show that a simple-sum aggregate is inappropriate because substitution possibilities are finite among these assets. However, the estimation of elasticities of substitution does not provide evidence on the weak separability of a particular asset collection; as such, these results should be regarded as proxies for the necessary and more rigorous tests of separability.[2/]

A second line of work deals with the effects of NOW accounts on the money-GNP relationship based on *ad hoc* adjustments to M1. Hafer (1984), for example, cites turnover data on NOW accounts as evidence that they are used as savings balances. After subtracting all balances in other checkable deposits from M1, his results from money demand and reduced-form GNP equations indicate that this adjusted measure of M1 is more closely related to aggregate spending and explains a larger portion of the 1982-83 velocity decline. Similar practices, with varying conclusions, are found in Wenninger (1984). Turnover data for one institution also have been used by Stern, Supel and Quah (1984) to argue that MMMFs do not behave like money.

The final line of work related to financial innovations includes the research on Divisia monetary aggregates by Barnett and his colleagues [Barnett (1980, 1981, 1982, 1983, 1984); Barnett, Offenbacher and Spindt (1981, 1984); and Barnett and Spindt (1982)]. The motivation for this work is that official simple-sum aggregates give equal weight in M1 to currency, demand deposits, NOWs and Super NOWs even though each asset has a separate and distinct set of characteristics. For example, whereas each asset can be used directly in transactions, balances in Super NOWs earn interest and are subject to minimum balance requirements and check fees. The Divisia studies provide theoretical and empirical support for the intuitive notion that dollars held in different ways do not provide the same value of monetary services and should not be given equal weight in a monetary aggregate.

The Divisia studies, however, do not question the current composition of the official aggregates; instead, only the weights given to existing components are changed. For example, while currency and NOWs probably should receive different weights in M1, it is not clear that NOWs belong in M1 as a close substitute for currency. Similarly, it is not clear that MMDAs, currently in M2, do not provide monetary services similar to the services of M1 balances.

IV. ASSESSING THE "MONEYNESS" OF THE NEW ACCOUNTS

Assumptions Regarding Multi-Step Budgeting and Separability

To test whether a particular asset collection can be regarded as a weakly separable commodity block, we assume the existence of a set of demand equations derived from the consumer problem of minimizing expenditures on all commodities subject to achieving some specified level of utility. We follow Samuelson (1947), Friedman (1959) and Patinkin (1965) in assuming that, because the characteristics of various assets provide utility for individuals, holdings of real financial assets can be entered as arguments in the representative utility function. By taking this approach, financial assets are treated in the same manner as other commodities that provide utility--such as food and clothing.

After writing a general utility function that includes money and other commodities, we assume that this function is weakly separable in financial assets, an assumption that is consistent with a multi-step budgeting process in which, subject to their expenditure constraints and group price indices, individuals first allocate budget shares across broad commodity groups, such as "food", "shelter," and "financial assets." Once broad decisions are made to allocate, for example, 20 percent of the budget to food and 40 percent to the services of financial holdings, further budgeting decisions are made concerning how these broad shares will be allocated among specific commodities within each commodity group.[3/]

In other words, for N financial assets, the demands in some time period can be modeled using the objective

$$\max u = u(x_1, x_2, \ldots, x_N)$$

$$\text{s.t.} \sum_{i=1}^{N} P_i X_i = M$$

where M denotes expenditures on the services of financial assets and X_i is the quantity held of the ith asset. The user cost, P_i, is based on Barnett's (1978) formula.4/

At first glance it might appear that a model of flow demands is being applied incorrectly to the holdings of financial assets (wealth), which normally are considered to be a stock concept. It is important to note, however, that the budget constraint is expressed in expenditure (i.e., flow) terms. This transformation is possible because the stock expressions for the quantities of various financial assets are multiplied by their user costs before they are entered into the model. By noting that user costs are the rental prices of the services provided by durable goods and assuming that services are proportional to stocks, multiplying stock holdings of financial assets by their respective user costs produces a flow measure of expenditures on the services of the stocks.5/ When transformed in this manner, it is appropriate to apply a flow demand model to explain the determination of expenditures on the transactions services of alternative financial assets. Moreover, stating the problem in terms of expenditures on monetary services is consistent with a two-stage budgeting process (i.e., weak separability).

There are two approaches to analyzing the allocation of a fixed budget among the specific goods of interest in demand analysis. The most common one of specifying a functional form for demand curves and estimating the parameters which determine elasticities can be thought of as the parametric approach. An example of this approach is the paper by Ewis and Fisher which uses the translog expenditure system.

However, it is possible to make use of the axioms of revealed preference originally due to Samuelson (1938) and Houthakker (1950) to examine many of the same characteristics of the demand for a set of goods, without the possibly restrictive selection of a functional form. This approach, termed the nonparametric approach by Varian since it does not rely on a parameterization of each demand curve, is thus freed from the possible specification bias due to incorrect functional forms.

Of particular interest is the fact that one can test a set of observed prices and quantities for two properties--(i) the existence of a stable utility function consistent with the data; and (ii) the compatibility of the data set with the existence of a utility function which is weakly separable in some subset of the goods. Let us designate these properties as consistency and separability.

Varian showed that the property of consistency requires that the data exhibit no violations of the Generalized Axiom of Revealed Preference (GARP). This axiom is equivalent to the existence of a well-behaved utility function which, when maximized subject to a budget constraint by a rational consumer, could have generated the observed data; that is, a utility function exists which rationalizes the data. Both Varian and Diewert and Parken examined the question of weak separability using the nonparametric approach. If a subset of the goods satisfies GARP, and the resulting aggregate along with the other goods still satisfy the consistency property, then one has a stronger result: a utility function exists which would rationalize the data which is consistent with weak separability.

We tested these properties using the following method. Assets were arranged in order of liquidity--1=currency, 2=demand deposits, 3=NOWs, 4=super NOWs, 5=MMDAs, 6=MMMFs, 7=savings. The user costs for these seven assets were calculated using the methods outlined above. Quantities and user costs were available for 29 months, April 1983 to August 1985.[6/]

The first step was to check for consistency of these data with GARP. We found no violations, thus establishing the existence of a utility function which rationalizes this data set.

Weak separability can be imposed if it is possible to satisfy GARP with some smaller group of assets. This is not guaranteed, even if a larger group is found to be consistent. A second check is performed after construction of a subutility function--are the subutilities themselves consistent with utility maximization at the first stage?

Our results showed that any subaggregate of the first four assets can be treated as weakly separable--the groups (C, DD), (C, DD, NOWs) and (C, DD, NOWs, Super-NOWs) are each consistent with GARP. Furthermore, the macro-utility functions formed by putting these micro, subutility functions in as an aggregate, viz.

$$u = u(f(C,DD),Nows,Spnows,MMDAs,MMMFs,Svgs)$$

and so on, are consistent with utility maximization. Thus, one is able to define aggregates consisting of any of these three collections of assets beginning with currency and demand deposits.

We were unable to add MMDAs to the group of four assets--GARP was satisfied for this group, but the Afriat numbers could not be constructed to establish consistency of the remaining two assets and the subutility function defined over the first five assets. When the sixth asset (MMMFs) was added, we found GARP to be violated as well, so the group of six cannot be treated as weakly separable.

V. PERFORMANCE OF ADMISSIBLE AGGREGATES

The foregoing results and the functional elimination of separate NOW-Super NOW categories in 1986 suggest admissible aggregates that correspond to M1A (currency plus demand deposits) and current M1. With an option to use simple-sum or Divisia weights in constructing these aggregates, the set of potential aggregates expands to four: simple-sum M1A and M1 and Divisia M1A and M1. The performance of these aggregates as an intermediate target variable is examined below against two traditional benchmarks: their correspondence with monetary policy's ultimate goal variable, the growth rate of GNP, and their controllability.

A. Performance in a St. Louis Equation: In-Sample

A traditional means of evaluating a monetary aggregate is to examine its performance in a spending equation like the St. Louis equation. In addition to comparisons of descriptive statistics, it offers a means of testing a maintained hypothesis that growth in the money stock and nominal GNP correspond one-to-one. Typically, the St. Louis equation is written as:

$$\dot{Y}_t = \alpha + \sum_{i=0}^{p} \beta_i * \dot{M}_{t-i} + \sum_{j=0}^{q} \tau_j * \dot{EP}_{t-j} + \sum_{k=0}^{r} \delta_k * \dot{E}_{t-k} + \tau * S_t$$

where Y is nominal GNP, M is a measure of the money stock, EP is the relative price of energy, E is high employment government expenditures and S is the number of work days lost due to strike activity; dots over variables indicate annualized rates of change. Table 1 reports the results of estimating this equation across the four potential monetary aggregates mentioned for a II/1962-I/1986 sample of quarterly data. Lag lengths for right-hand-side variables were determined in pre-test estimation by a final prediction error (FPE) criterion; in each case, this test indicated that the proxy for fiscal policy, $\dot{E}$, added no significant explanatory power and, on this basis, was dropped from the estimating equation.

Discussing the results for M1 first, rows 3 and 4 of the table indicate the inferior performance of this asset grouping in several places. For both the Divisia and simple sum measures, the explanatory power is one-third less than that of the M1A measures, there is marginal evidence of serial correlation and the sum of coefficients for the money stock measure is significantly less than one; it should be noted that a similar equation estimated over a sample that ends prior to the era of financial innovations reverses each of these results. Moreover, the intercept terms estimated to be near 5 clearly are at odds with historical evidence on the trend growth rate of velocity.

The top two rows of the table show M1A to fare much better. Evidence of serial correlation disappears and $\bar{R}^2$ rises to about 0.35, a level typically reported in pre-1981 spending equations. Also in contrast to the M1 equations, the sum of coefficients for the lagged money stock terms is not significantly different from one. If there is any criterion for distinguishing between Divisia and simple sum M1A measures on the basis of in-sample results, it would appear to be the implied 3.4 percent growth rate of velocity for the Divisia measure that is more in line with historical trends. Overall, however, these measures exhibit similar in-sample behavior in a spending equation.

B. Performance in a St. Louis Equation: Out-of-Sample

As an additional check on the performance of the admissible aggregates as a guide to policy, their out-of-sample performance over the episode of financial innovations was examined. The St. Louis equations reported above first were re-estimated over a sample ending in IV/1981. The estimated coefficients and actual ex post data values then were used to simulate values for GNP growth over I/1982-I/1986. Error statistics based on the discrepancy between actual and simulated values for these 17 quarters are reported in table 2.

The results again clearly indicate the inferior performance of either M1 measure relative to the M1A measures. The RMSEs for M1 are more than 50 percent larger than those for M1A and the other error statistics are worse by even larger orders of magnitude. The error statistics do not reveal substantial differences between the two M1A measures, although simple sum M1A generates somewhat smaller values for each error statistic. The only clear verdict from table 2 is that the asset grouping M1, however weighted, is inferior to the more narrow M1A.

C. Controllability

A second issue for the practical use of an aggregate as an intermediate target is its controllability. Even if an aggregate were to share a close and predictable relationship with GNP, it would not be useful as a target if it were not controllable. Most simply, this implies that the growth rate of the intermediate target must have a contemporaneous one-to-one correspondence with the growth rate of the adjusted monetary base (AMB). Moreover, this simple equation should not exhibit any significant serial correlation, which would imply a misspecification of the relationship.

This relationship for each of the four aggregates is reported in table 3. For each of the four money stock measures the coefficient for contemporaneous base growth is not significantly different from one; thus, each admissible aggregate passes this simple test. Closer inspection of the results, however, provides further grounds for preferring Divisia M1A to simple sum M1A. Not only is the explanatory power for the Divisia measure two-thirds greater than for the simple sum measure but the simple sum M1A-monetary base relationship indicates significant serial correlation. This evidence of misspecification and its absence from the Divisia M1A equation clearly indicate a preference for Divisia M1A with regard to controllability.[7/]

VI. CONCLUSIONS

Uncertainty about the impact of interest-bearing checking deposits on the targeted monetary aggregates has received much discussion but alternative points of view have been based on little empirical evidence. The evidence that does exist is based on data ending prior to the new financial innovations or *ad hoc* adjustments to money demand regressions.

This study employs a consistent approach to estimating the effects of interest-bearing checking deposits and other innovations on the composition of the monetary aggregates. Without reliance on assumptions about functional form and by testing for the consistency of observed data with the existence of macro- and micro-utility functions, it is possible to test whether some groups of financial assets are weakly separable from other assets. The results indicate that both M1A and current M1 satisfy Barnett's admissibility criterion and that checkable deposit accounts included in M2 (e.g. MMDAs, MMMFs) are not properly treated as money. On the basis of further tests of these potential aggregates in a spending equation, both in-sample and out-of-sample statistics support the more narrow aggregation of M1A. Although the simple-sum and Divisia weighting schemes for M1A produce similar results, other theoretical grounds and statistical evidence on controllability indicate a preference for Divisia M1A.

FOOTNOTES

1/

2/We thank William Barnett for this point.

3/Weak separability is not a necessary or sufficient condition for the budgeting process itself but only for its second stage. Further restrictions are required for the first stage.

4/This is based on Barnett's (1978) user cost formula. He derives the expression:

$$P_{it} = \frac{P^*_t \, (R_t - r_{it})(1-M)}{1+R_t \, (1-M)}$$

where P* is a true cost of living index, R_t is some benchmark rate of return, r_{it} is the observed nominal own rate of return on asset i and M is the marginal tax rate. For purposes of this study P^*_t is the geometric mean of the CPI and the GNP deflator and R_t is the Baa corporate bond rate. The own rate of interest (r_{it}) on currency is assumed to be zero. The implicit own rate on demand deposits is estimated by Klein's (1974) formula, which is written $r_D = r_I(1-R/D)$ where r_I is the return on bank investments (proxied by the three-month commercial paper rate) and R/D is the marginal reserve to deposit ratio.

The Baa corporate bond rate was chosen as our benchmark (R_t) because it was greater than all own-rates of interest (r_{it}) on other assets; this is a necessary condition to make user costs positive. Barnett and Spindt have found their experiments with Divisia Indices to be robust with respect to choice of R_t.

5/ See Donovan (1978); Barnett (1981), p. 197; and Barnett and Spindt, pp. 5-6.

6/ The sample period was begun after initial flows into Super NOWs and MMDAs were completed and changes from these levels could be analyzed.

7/ An explanation for the closer correspondence of Divisia M1A with the adjusted monetary base is that its weighting scheme resembles that of the base. Most simply, it is possible to write: currency + ρ * demand deposits = base, where $0 < \rho < 1$. In simple-sum M1A, currency and demand deposits are weighted equally, whereas, in a Divisia framework, demand deposits receive less weight than currency. Furthermore, under certain simplifying assumptions, the numerator of the Divisia weight for demand deposits depends primarily on $r_I(R/D)$, where R/D is the marginal reserve to deposit ratio. This term, which would smooth fluctuations in the currency to demand deposit ratio, is likely responsible for smoothing Divisia M1A and producing its more stable relationship with the base.

REFERENCES

Afriat, S. "The Construction of a Utility Function from Expenditure Data," International Economic Review (1967), pp. 67-77.

Barnett, William A. "The User Cost of Money" Economics Letters, Vol. 1 (1978), pp. 145-49.

_____. "Economic Monetary Aggregates: An Application of Aggregation and Index Number Theory," Journal of Econometrics (September 1980), pp. 11-48.

_____. Consumer Demand and Labor Supply: Goods, Monetary Assets and Time (Amsterdam: North Holland, 1981).

_____. "The Optimal Level of Monetary Aggregation," Journal of Money, Credit and Banking (November 1982, part 2), pp. 687-710.

_____. "New Indices of Money Supply and the Flexible Laurent Demand System," Journal of Business and Economic Statistics 1 (January 1983), pp. 7-23.

_____. "Recent Monetary Policy and the Divisia Monetary Aggregates," The American Statistician (August 1984), pp. 165-72.

Barnett, William, Edward Offenbacher and Paul Spindt. "New Concepts of Aggregated Money," Journal of Finance (May 1981), pp. 497-505.

_____. "The New Divisia Monetary Aggregates," Journal of Political Economy (December 1984), pp. 1049-85.

Barnett, William A., and Paul A. Spindt. Divisia Monetary Aggregates: Compilation, Data and Historical Behavior, Staff Study #116, Board of Governors of the Federal Reserve System, May 1982.

Becker, Gary J. "A Theory of the Allocation of Time," The Economic Journal (September 1965), pp. 493-517.

Boughton, James. "Money and its Substitutes," Journal of Monetary Economics (1981), pp. 375-86.

Chetty, V. K. "On Measuring the Nearness of Near-Moneys," American Economic Review (1969), pp. 270-81.

Diewert, W.E. "Applications of Duality Theory," in Frontiers of Quantitative Economics, vol. 2, M. Intriligator and K. Kendrick, eds. (North-Holland, 1974), pp. 106-71.

_____. "Exact and Superlative Index Numbers," Journal of Econometrics (1976), pp. 115-146.

_____, and C. Parken. "Test for Consistency of Consumer Data and Nonparametric Index Numbers," University of British Columbia, Working Paper 78-27, 1978.

Donovan, Donald J. "Modelling the Demand for Liquid Assets: An Application to Canada," International Monetary Fund Staff Papers (1978), pp. 676-704.

Ewis, Nabil A., and Douglas Fisher. "The Translog Utility Function and the Demand for Money in the United States," Journal of Money, Credit, and Banking (February 1984a), pp. 34-52.

_____. "Toward a Consistent Estimate of the Substitutability of Money and Near Monies," _Journal of Macroeconomics_ (1984b).

Feige, Edgar L. and Douglas K. Pearce. "The Substitutability of Money and Near Monies: A Survey of the Time-Series Evidence," _Journal of Economic Literature_ (June 1977), pp. 439-69.

Friedman, Milton. "The Demand for Money: Some Theoretical and Empirical Results," _Journal of Political Economy_ (August 1959), pp. 327-51.

Gallant, A. Ronald and Gene H. Golub. "Imposing Curvature Restrictions on Flexible Functional Forms," _Journal of Econometrics_ 26 (December 1984), pp. 295-321.

Hafer, R. W. "The Money-GNP Link: Assessing Alternative Transactions Measures," this _Review_ (March 1984), pp. 19-27.

Houthakker, Hendrik S. "Revealed Preference and the Utility Function," _Economica_ (1950), pp. 159-74.

Husted, Steven and Mark Rush. "On Measuring the Nearness of Near Moneys: Revisited," _Journal of Monetary Economics_ (1984), pp. 171-81.

Klein, Benjamin. "Competitive Interest Payments on Bank Deposits and the Long-Run Demand for Money," _American Economic Review_ (December 1974), pp. 931-49.

Lancaster, Kelvin J. "A New Approach to Consumer Theory," _Journal of Political Economy_ (April 1966), pp. 132-57.

Offenbacher, Edward K. The Substitutability of Monetary Assets. Unpublished Ph.D. Thesis, University of Chicago, 1979.

_____. "Disaggregated Monetary Asset Demand Systems: Estimation and an Application of the Preference Independence Transformation," Special Studies Paper No. 144, Federal Reserve Board, Washington, D.C., July 1980.

Patinkin, Don. Money, Interest, and Prices: An Integration of Monetary and Value Theory (Harper and Row, 1965).

Phlips, Louis. Applied Consumption Analysis (Amsterdam: North-Holland Publishing Company, 1974).

Samuelson, Paul A. Foundations of Economic Analysis (Cambridge, MA: Harvard University Press, 1947).

Spindt, Paul A. "Money Is What Money Does: A Revealed Production Approach to Monetary Aggregation," Special Studies Paper No. 177, Federal Reserve Board, Washington, D.C., June 1983.

Stern, Gary, Thomas M. Supel and Danny Quah. "Money Market Mutual Funds Are Hardly Money," Federal Reserve Bank of Minneapolis Quarterly Review (Summer 1984), pp. 3-8.

Varian, Hal R. "The Nonparametric Approach to Demand Analysis," Econometrica (1982), pp. 945-74.

Wenninger, John. "The M1-GNP Relationship: A Component Approach," Federal Reserve Bank of New York Quarterly Review (Autumn 1984), pp. 6-15.

Table 1
Performance of Alternative Money Stock Measures in a St. Louis Equation: II/1962-I/1986

Simple Sum M1A:
$$\dot{Y}_t = \underset{(5.10)}{4.556} + \underset{(1.39)}{0.782^*} \sum_{i=0}^{3} \dot{M}_{t-i} + \underset{(3.15)}{0.118^*} \sum_{j=0}^{6} \dot{EP}_{t-j} - \underset{(3.60)}{0.924^*} S_t$$

$\bar{R}^2 = 0.34$ DW = 1.86 SER = 3.723

Divisia M1A:
$$\dot{Y}_t = \underset{(3.05)}{3.378} + \underset{(0.55)}{0.90^*} \sum_{i=0}^{3} \dot{M}_{t-i} + \underset{(2.17)}{0.078^*} \sum_{j=0}^{6} \dot{EP}_{t-j} - \underset{(3.59)}{0.912^*} S_t$$

$\bar{R}^2 = 0.35$ DW = 1.83 SER = 3.712

Simple Sum M1:
$$\dot{Y}_t = \underset{(4.01)}{4.70} + \underset{(2.46)}{0.586^*} \sum_{i=0}^{2} \dot{M}_{t-i} + \underset{(2.40)}{0.093^*} \sum_{j=0}^{6} \dot{EP}_{t-j} - \underset{(3.45)}{0.935^*} S_t$$

$\bar{R}^2 = 0.24$ DW = 1.59 SER = 3.990

Divisia M1:
$$\dot{Y}_t = \underset{(3.83)}{5.477} + \underset{(2.42)}{0.487^*} \sum_{i=0}^{4} \dot{M}_{t-i} - \underset{(3.51)}{0.966^*} S_t$$

$\bar{R}^2 = 0.22$ DW = 1.50 SER = 4.040

NOTE: Absolute values of t-statistics in parentheses
NOTE: The t-statistic for the sum of coefficients for the money stock measure applies to the null hypothesis: $\Sigma \beta_i = 1$.

Table 2
Out-of-Sample Error Statistics for GNP Projections: I/1982-I/1986

	RMSE	MAE	Mean Error
Simple Sum M1A	4.437	3.699	1.765
Divisia M1A	4.730	4.005	2.625
Simple Sum M1	7.417	6.633	6.010
Divisia M1	7.241	6.252	5.431

Table 3
Controllability of Admissible Monetary Aggregates

Simple Sum M1A: $\dot{M}_t = -4.211 + 0.886\ \dot{AMB}_t$
$\qquad\qquad\qquad (1.35) \quad (0.85)$

$\bar{R}^2 = 0.30 \quad DW = 1.31 \quad SER = 10.025$

Divisia M1A: $\dot{M}_t = -3.230 + 0.952\ \dot{AMB}_t$
$\qquad\qquad\qquad (1.53) \quad (0.52)$

$\bar{R}^2 = 0.52 \quad DW = 1.56 \quad SER = 6.801$

Simple Sum M1: $\dot{M}_t = -3.832 + 1.085\ \dot{AMB}_t$
$\qquad\qquad\qquad (1.41) \quad (0.73)$

$\bar{R}^2 = 0.46 \quad DW = 1.71 \quad SER = 8.746$

Divisia M1: $\dot{M}_t = 0.362 + 0.936\ \dot{AMB}_t$
$\qquad\qquad\qquad (0.15) \quad (0.60)$

$\bar{R}^2 = 0.43 \quad DW = 2.01 \quad SER = 8.030$

NOTE: Absolute values of t-statistics in parentheses
NOTE: t-statistics for AMB applies to the null hypothesis: $\hat{\beta} = 1$.