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Building New Monetary Services Indices: Concepts, Methodology and Source Data

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ABSTRACT

This paper is second of two from the Monetary Services Indices (MSI) Project at the Federal Reserve Bank of St. Louis. The first paper, Working Paper 96-007B, surveys the microeconomic theory of the aggregation of monetary assets. This paper describe a new database of monetary services indices (MSI) for the United States. The MSI measure the flow of monetary services received each period by households from their holdings of monetary assets; the levels of the indices are often also referred to as Divisia monetary aggregates. In addition to indices of the flow of monetary services, the database contains dual user cost indices, measures of potential aggregation error in the monetary services indices, and measures of the stock of monetary wealth. An overview of the Project and the concept of monetary aggregation is included here as a preface.

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Introduction to the St. Louis Monetary Services Index (MSI) Project

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Economists have long recognized that the equilibrium between the demand and the supply of money is the primary long-run determinant of an economy's price level. There is far less agreement, however, on how to *measure* the aggregate quantity of money in the economy. The Federal Reserve Bank of St. Louis' monetary services index project seeks to provide researchers and policy makers with an extended database of new monetary services indices and related data.[1]

Measurement of the MSI differs considerably from that of the monetary aggregates that have been published by the Federal Reserve Board for more than 35 years, even though both begin with the same basic observation: households choose to hold monetary assets, in equilibrium, because the assets provide valuable services to the household. In other words, the household's level of utility is higher when they choose to hold positive, rather than zero,

* The authors thank the referees William A. Barnett and Adrian Fleissig for their careful comments on this this research. Any remaining errors are, of course, the responsibility of the authors.

[1] The monetary services indices have sometimes been referred to as Divisia monetary aggregates because their construction uses a discrete approximation to Divisia's (1925) continuous time index. The label MSI emphasizes the fact that the indices measure the flow of monetary services received, rather than the outstanding stock of monetary assets (which is the discounted value of that flow).

quantities of monetary assets, given their budget constraint. The increased utility arises, in part, because some of the assets are medium of exchange: other things equal, a larger quantity of such assets increases utility by reducing shopping time, permitting immediate purchase of bargain priced goods, providing a cushion against unanticipated expenses, and reducing the amount of time spent on cash management. Assets that are not medium of exchange, such as mutual fund shares and savings and time deposits, may also increase utility, in particular, if they are convertible to medium of exchange at relatively low cost.[2] Samuelson (1947, p. 117-8), for example, noted that

> ...it is a fair question as to the relationship between the demand for money and the ordinal preference fields met in utility theory. In this connection, I have reference to none of the tenuous concepts of money, as a numeraire commodity, or as a composite commodity, but to money proper, the distinguishing features of which are its indirect usefulness, not for its own sake but for what it can buy, its conventional acceptability, its not being "used up" by use, etc.
>
> Possession of an average amount of it [money] yields convenience in permitting the consumer to take advantage of offers of sale, in facilitating exchanges, in bridging the gap between receipt of income and expenditure, etc. The average balance is both used and at the same time not used; it revolves but is not depleted; its just being there to meet contingencies is valuable even if the contingencies do not materialize, *ex post*. Possession of this balance then yields a real service, which can be compared with the direct utilities from the consumption of sugar, tobacco, etc. in the sense that there is some margin at which the individual would be indifferent between having more tobacco and less of a cash balance, with all of the inconvenience which the latter condition implies.

Monetary aggregates published by the Federal Reserve Board are constructed by simply summing the total dollar values of the included assets.[3] Summation implicitly assumes that the

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[2] Although most money market mutual funds allow customers to write "checks", shares in the fund are not medium of exchange. The checks themselves are drawn against a bank demand deposit owned by the mutual fund firm, an account that is replenished by the liquidation of the customer's shares.

[3] The first monetary aggregate published by the Federal Reserve, M1, was constructed in 1960 at the Federal Reserve Bank of St. Louis (Abbott, 1960). In April 1971, the Federal Reserve Board introduced two additional monetary aggregates, M2 and M3. The monetary aggregates currently published by the Federal Reserve Board differ only slightly from the revised definitions introduced in 1980 (see Anderson

monetary assets that are included in the aggregate are regarded as perfect substitutes by their owners. Microeconomic theory demonstrates that when rational decision makers are allocating resources over perfect substitutes they choose corner solutions. Thus, simple sum monetary aggregation is only consistent with microeconomic theory in the case where economic decision makers hold only one monetary asset.

In contrast, the monetary services indices (MSI) are based on explicit models of microeconomic decision making that do not make strong prior assumptions about the elasticities of substitution between monetary assets. For example, household demand for monetary assets can be modeled as the decision of a representative household which maximizes a utility function, $U(m_1,\ldots,m_n, q_1,\ldots,q_m)$, that includes both real stocks of monetary assets $m=(m_1,\ldots,m_n)$ and quantities of non-monetary goods and services $q=(q_1,\ldots,q_m)$.[4] In this model, monetary assets are treated as durable goods in the utility function, furnishing a flow of monetary services to the household. Stocks of monetary assets are assumed to depreciate, but to not fully depreciate within one period.[5] Expressions for the rental prices, or user costs, of monetary assets were derived by Barnett (1978).[6] In real terms, the user cost of a particular monetary asset is the discounted spread between a rate of return on an asset that does not furnish monetary services (called the benchmark asset) and the own rate of that particular monetary asset. The spread is

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and Kavajecz, 1994; Kavajecz, 1994; and Whitesell and Collins, 1996). Current data are published in the Board's H.6 release and the *Federal Reserve Bulletin*.

[4] For exposition, we restrict this discussion to a simple household model. Anderson, Jones, and Nesmith (1997a) discuss an intertemporal version of the household model, as well as extensions of the household model to other decision makers, such as profit maximizing firms.

[5] Treating money as a consumer durable in household utility functions dates (at least) from Walras (1896, 1954). Non-interest bearing money (such as cash) is assumed to depreciate at the inflation rate. For a precise statement of the depreciation rate of interest bearing monetary assets see Anderson, Jones, and Nesmith (1997a).

[6] Donovan (1978) provides a definition for the current period user costs of monetary assets that are the same as Barnett's (1978) general definition in the current period. Barnett (1978) also derived the user costs of monetary assets in future periods. In addition, Barnett (1987) extends the definition of user costs to the case of manufacturing firms and financial intermediaries.

discounted to account for the payment of interest at the end of the period. Thus, the user cost of a monetary asset is the (discounted) interest foregone by the household as a result of choosing to hold the asset.

More precisely, assume that the household maximizes the utility function $U(m_1,\ldots,m_n,q_1,\ldots,q_m)$ subject to the budget constraint

$$\sum_{i=1}^{n}\pi_i m_i + \sum_{j=1}^{m} p_j q_j = Y,$$

where $\pi = (\pi_1,\ldots,\pi_n)$ is the vector of user costs of monetary assets m, Y is the household's total expenditure on non-monetary goods and services and on the services of monetary assets, and $p = (p_1,\ldots,p_m)$ denotes the vector of prices of q. Solving the household's constrained utility maximization problem yields demand functions for real monetary assets and for quantities of non-monetary goods and services

$$m_i^* = f_i(\pi, p, Y), \qquad i = 1,\ldots,n$$

$$q_j^* = g_j(\pi, p, Y), \qquad j = 1,\ldots,m$$

The optimization problem is discussed in detail in Anderson, Jones and Nesmith (1997a).[7]

In macroeconomics, the problem of creating a smaller number of monetary aggregates from the individual monetary assets $m_1,\ldots,m_n$ naturally arises. In general, constructing a monetary aggregate by simply summing the dollar values of the individual assets is not consistent with economic theory unless economic agents (households or firms) regard all of the monetary assets as perfect substitutes. A method of aggregation that is consistent with economic theory

[7] Equivalently, a manufacturing firm can be viewed as maximizing profit subject to a production function which contains monetary assets, as in Barnett (1987). This model produces factor demand functions for monetary assets and other inputs to production which are functions of the factor prices of non-monetary inputs and monetary asset user costs (which are the same as the user costs in the household case).

was suggested by Barnett (1980).[8] In his formulation, the household's utility function is assumed to be weakly separable in monetary assets, and may be written $F(u(m_1,\ldots,m_n), q_1,\ldots,q_m)$, where the function u is called a category subutility function.[9] In this case, the marginal rate of substitution between monetary assets m_i and m_j is $\frac{\partial u(m_1,\ldots,m_n)}{\partial m_i} / \frac{\partial u(m_1,\ldots,m_n)}{\partial m_j}$, which is independent of the quantities of all other goods $q_1,\ldots,q_m$.[10] In this form, the household can solve its utility maximization problem in two stages. In the first stage, the household chooses the shares of total household expenditure that it wishes to spend on real monetary services and on quantities of individual non-monetary goods and services. In the second stage, conditional on not exceeding the expenditure on monetary services selected in the first stage, the household selects the real stocks of monetary assets m_i that will provide the largest possible quantities of monetary services.

This two-stage budgeting model of household behavior implies that there exists an aggregator function, u, that measures the total amount of monetary services that the household receives from its holdings of monetary assets $m_1,\ldots,m_n$; the function defines a monetary aggregate as $M = u(m)$.[11] Even with this result, however, a difficulty remains: the specific functional form of the monetary aggregate depends on the household's utility function, which is unknown. Following the theoretical advances of Diewert (1976) and Barnett (1980), the monetary aggregate may be approximated by a statistical index number. The MSI developed in

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[8] See also Barnett (1981). Additional references to Barnett's work are included in the following article.

[9] The equivalent condition for the case of a manufacturing firm is weak separability of the production function in monetary assets, see Barnett (1987).

[10] For a formal discussion of weak separability and its implications, see Goldman and Uzawa (1964). This statement of the separability assumption includes only current period monetary assets and goods. A more complete statement is that the household's choice over current period monetary assets be weakly separable from its choice over all future period monetary assets and all current and future period quantities of non-monetary goods and services (see Anderson, Jones, and Nesmith, 1997a).

the St. Louis project are based on a high quality statistical index number; details of their construction are discussed in Anderson, Jones and Nesmith (1997b).

The methodology outlined above for construction of the MSI lies solidly in the mainstream of current macroeconomic research. The theory and methods are similar to those now being used by the Department of Commerce to produce improved economic aggregates such as GDP and the GDP deflator (see Triplett, 1992, and Young, 1992, 1993).[12] An advantage of the MSI approach is that it produces an internally consistent "dual" opportunity cost, which relates to the MSI in the same way that the GDP deflator, produced by the Commerce Department, relates to GDP. In addition, the methods are similar to those of modern general-equilibrium business cycle models which often begin with the hypothesis of an optimizing microeconomic representative agent (Cooley and Hansen, 1995). To the extent that such complementary developments in measurement and modeling improve our understanding of economic fluctuations, the MSI may prove particularly valuable.

Recent research also suggests that empirical conclusions regarding issues such as the interest and income elasticities of money demand and the long-run neutrality of money may be sensitive to the choice of monetary aggregate. In other words, empirical conclusions may differ when "money" is measured by the flow of monetary services rather than by simple summation of the dollar amounts of monetary assets, see Barnett, Offenbacher, and Spindt (1984), Barnett, Fisher, and Serletis (1992), Chrystal and MacDonald (1994), and Belongia (1996). Such findings have spurred the construction of MSI data for many countries. Academic studies include: la Cour (1996) for Denmark; Janssen and Kool (1994) for the Netherlands; and Lim and

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[11] See Green (1964) for more discussion of two stage budgeting and aggregation theory.

[12] The recent revisions in the Department of Commerce aggregates reflect two improvements. The old aggregates were fixed base Laspeyres index numbers. These have been improved to reflect advances in index number theory. The new aggregates are chained superlative indices. The monetary indices in

Martin (1994) for Australia. Central bank studies include: Herrmann, Reimers and Toedter (1994) for Germany; Ishida and Nakamura (1994) for Japan; Longworth and Atta-Mensah (1995) for Canada; and Fisher, Hudson and Pradham (1993) for the United Kingdom. Unique among central banks, the Bank of England publishes monetary services indices alongside other monetary aggregates.

Monetary services indices for the United States have been produced previously: by Barnett (1980), Barnett and Spindt (1982), Farr and Johnson (1985), and Thornton and Yue (1992). While this project is a continuation of previous research, it is not an extension of any previous series. The assumptions and methodology used in the construction of the MSI were examined for sustainability and credibility, resulting in a new series of indices which are detailed in Anderson, Jones and Nesmith (1997a,1997b).[13] The first article surveys the literature on the aggregation of monetary assets, seeking to synthesize theoretical results not readily available elsewhere in a single source. Because the analysis is based on the dynamic theory of utility maximization, some aspects are necessarily technical. Readers primarily interested in understanding the construction of the MSI and related data might prefer to move directly to the second article which provides a detailed road map to the MSI database. In addition to the MSI and their dual indices, the data include own-rates of return for some of the monetary assets in the MSI, and the user cost and asset stock data for all the monetary assets included in the MSI. This will allow researchers to use the MSI database to study the demand functions for individual monetary assets, as well as the aggregate monetary service flow. The database also includes other heretofore unpublished indices, such as the second moments of the MSI which were suggested by Barnett and Serletis (1990) as useful measures of the amount of (statistical)

Anderson, Jones, and Nesmith (1997b) are also chained superlative indices. Thus, the monetary services indices (MSI) have the same statistical properties as the Department of Commerce aggregates.

aggregation error contained in the MSI, the CE index which was suggested by Poterba, Rotemberg, and Driscoll (1995), and total expenditures on monetary assets.

The St. Louis' MSI database is maintained by the staff of the Federal Reserve Bank of St. Louis as a part of the Bank's Federal Reserve Economic Database (FRED).[14] To facilitate comparison with monetary aggregates published by the Federal Reserve Board, indices in the database are provided for the same groupings of monetary assets -- M1, M2, M3, and L -- as well as for other widely-used aggregates such as M1A (currency plus non-interest-bearing checkable deposits) and MZM (M2 less small time deposits). The indices, which will be provided at monthly, quarterly, and annual frequencies, will be updated and revised as data become available.

In addition to providing the MSI and related data, the St. Louis MSI project seeks to stimulate research on the role of monetary and financial variables in the conduct of monetary policy. In support of this goal, the MSI database also contains all underlying nonconfidential source data and the computer programs used to construct the indices.

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[13] In addition, many of the underlying series were previously taken from undocumented outside sources. In these cases, analogous series were constructed from documented sources. These constructions are detailed in Anderson, Jones and nesmith (1997b).

[14] FRED can be reached on the world wide web at www.stls.frb.org and by modem at (314) 444-1824.

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Building New Monetary Services Indices:

Concepts, Methodology and Data

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Introduction

This is the second of two papers that describe the project at the Federal Reserve Bank of St. Louis to construct a new database of monetary services indices (MSI), their dual user cost (price) indices, and other related indices and data. Unlike the official monetary aggregates published by the Board of Governors of the Federal Reserve System, the MSI and their dual user cost indices are statistical index numbers, based on economic aggregation and statistical index number theory.

In macroeconomic models, economists often seek to work with aggregates of economic variables rather than with numerous, individual variables. The measurement of these aggregates must satisfy certain conditions suggested by microeconomic theory, in order to interpret the

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behavior of the aggregates using the standard tools of microeconomics. *Measurement* of the aggregates and *interpretation* of their behavior are therefore intertwined, in ways that have often been overlooked in empirical economic research.

The minimal required conditions for measurement of these aggregates, which are the same for both monetary assets and non-monetary goods and services, are discussed in the previous article of this *Review* (Anderson, Jones, and Nesmith, 1997). The principal aggregates presented in this paper are the Monetary Services Index (MSI), which tracks the monetary quantity aggregate, and its dual user cost index. These indices are both *chained superlative index numbers*, and have the same theoretical and statistical properties as other chained superlative index numbers, including the Gross Domestic Product (GDP) and GDP Deflator produced by the Department of Commerce.

The MSI database is maintained by the staff of the Federal Reserve Bank of St. Louis and is available on-line as a part of the Bank's Federal Reserve Economic Database (FRED).[1] To facilitate comparison with the official aggregates, all of the indices in the database are provided for the same groupings of monetary assets as the official aggregates: M1, M2, M3, and L. Indices are provided at monthly, quarterly, and annual frequencies, and will be regularly updated and maintained as new data become available. The MSI database also contains all non-confidential data and computer programs used to construct the indices.

In this paper, we discuss the methodology and construction of the MSI and related indices. The remainder of this paper contains six sections followed by a brief conclusion. In the first section, we introduce notation. In the second section, we define each of the indices in the database, including: the nominal expenditure on monetary services; the nominal MSI (based on

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[1] FRED can be reached on the world wide web at www.stls.frb.org or by modem at (314) 444-1824.

the Törnqvist-Theil index number) and the real user cost index dual to the MSI; the currency equivalent index; the simple sum index; and a set of indices based on Theil's (1967) stochastic approach to index number theory.[2] We also discuss the connection between real and nominal (Törnqvist-Theil) MSI and their duals. This connection is important because, while the aggregation theory underlying these indices is developed in terms of the real stocks of monetary assets, actual monetary asset stock data are collected in nominal terms. The major result is that we can construct a nominal MSI and produce an approximation to the real MSI by deflating the nominal index.

In the third section, we describe the monetary asset stock data. We define the groupings of monetary assets for which we construct indices, and discuss the issue of weak separability. These groupings correspond to the definitions of M1, M2, M3, and L used in the official aggregates produced by the Federal Reserve Board. Because each group of assets is contained in the subsequent group, we refer to the groupings as the level of aggregation, with M1 being the narrowest level of aggregation and L being the broadest. We also produce indices for the M1A and MZM levels of aggregation.[3] M1A is a subset of M1 and MZM is a subset of M2.

In the fourth section, we discuss the own rate-of-return data used in the construction of the indices, and detail the data sources. In some cases, the sample period of the own rate data is shorter than that of the associated asset stock. When this occurs, we construct proxies for the own rate data, which are discussed in this section. We also detail our construction of own rates for particular monetary assets. Specifically, we construct the implicit rate of return on demand deposits, fixed and variable ceiling rates for rate regulated monetary assets, and the market rate

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[2] Derivation and interpretation of these indices is reviewed in Anderson, Jones, and Nesmith (1997).

[3] Simple sum M1A (non-interest bearing M1) was produced as an official monetary aggregate from 1960 (when all checkable deposits were non-interest bearing) through April 1970. MZM was suggested by William Poole; see note 8 below.

of return on savings bonds. Finally, we review own rate conversions and yield-curve adjustment of particular rates, which are necessary because not all own rates are reported on the same basis or for the same maturity.

In the fifth section, we detail the calculation of the user costs. One problem is that some asset stocks are simple summations of monetary assets which have different rates of return, and thus different user costs. We call these asset stocks *simple sum sub-indices*. We construct a user cost index which is dual to the simple sum sub-index. Finally, we discuss the concept of a benchmark asset and detail how we construct its rate of return.

In the sixth section, we address methodological issues deferred from earlier sections. The first is the difficulty for our aggregation caused by the introduction of new monetary assets. We implement Diewert's (1980) recommended solution to the problem. A second difficulty is created when asset stock data for particular monetary assets are combined into a simple sum sub-index. We argue that it is inappropriate to treat the resulting simple sum sub-index as a new asset because this would impute economic relevance to the change in definition. We detail our solution to this problem in the second subsection. The third issue is time aggregation. We use monthly data to construct the indices. In some applications, aggregate data at quarterly or annual frequencies may be necessary. We have implemented Diewert's (1980) time aggregation methodology to produce quarterly and annual indices. Finally, we discuss seasonality in the data.

MONETARY SERVICES INDICES (MSI) AND DUAL USER COSTS

Tracking the flow of monetary services with statistical index numbers requires developing "prices", or user costs, for monetary assets. Barnett (1978) derived the formula for the user costs of monetary assets, drawing on Diewert's analysis of the rental prices, or user costs, of durable goods (or durable physical capital). Although these concepts were introduced in the previous article, readers of that article are cautioned that this paper's notation differs somewhat because we distinguish between real and nominal assets. This distinction was not needed in the previous theoretical discussion.

The User Costs of Monetary Assets

Consider an economy with *n* monetary assets, say $m = (m_1, \ldots, m_n)$. Let m_{it}^{real} denote the real stock of monetary asset *i* chosen by an agent in period *t*, let r_{it} be the nominal holding period yield on monetary asset *i* in period *t*, let p_t^* be a true cost of living index in period *t*, and let R_t be the own rate of return on an asset that provides no monetary services during the agent's planning period except during the last period of the planning horizon. This last asset, called the *benchmark asset*, also may be interpreted as an asset that can be used by the agent solely to transfer wealth from one period to another; its rate of return R_t is called the *benchmark rate.*[4] Then, in the current period *t*, the nominal user cost of monetary asset *i* is a function of the difference between the benchmark rate and the asset's own rate of return r_{it}, discounted at the benchmark rate:

$$\pi_{it}^{nom} = p_t^* \left(\frac{R_t - r_{it}}{1 + R_t} \right)$$

(see Barnett, 1978). An agent's total expenditure on monetary services equals the sum of the products of the quantities and user costs of each monetary asset, or

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[4] An important issue in the construction of monetary services indices is that interest rates are not reported on a common basis. In later sections of the paper we will discuss appropriate conversions of the interest rate data. For now, we simply note that all of the r_{it} need to be reported on a common basis for the theory to apply.

$$y_t = \sum_{i=1}^{n} \pi_{it}^{nom} m_{it}^{real} .$$

Measuring the Flow of Monetary Services

The quantity (or flow) of monetary services received by an agent during any period is measured by an index number defined over the stocks of monetary assets held by the agent. Barnett (1980) first suggested the use of the Törnqvist-Theil statistical index number to track the flow of monetary services. The Törnqvist-Theil index is desirable because it is *superlative*, or in other words, because it can provide a second-order approximation to any arbitrary unknown homothetic economic aggregator function (see Diewert, 1976). Although there are many superlative index numbers, the Törnqvist-Theil statistical index number may be superior to others because its ability to furnish a second-order approximation is robust to violations of homotheticity (see Caves, Christensen, and Diewert, 1982).

The real monetary services (Törnqvist-Theil) index, MSI_t^{real}, is defined by

$$MSI_t^{real} = MSI_{t-1}^{real} \prod_{i=1}^{n} \left(\frac{m_{it}^{real}}{m_{i,t-1}^{real}}\right)^{\bar{s}_{it}} ,$$

where the average expenditure share on monetary asset *i* in period *t*, $\bar{s}_{it}$, is defined by

$$\bar{s}_{it} = \tfrac{1}{2}(s_{it} + s_{i,t-1}),$$

and the expenditure shares on monetary asset *i* in period *t* (s_{it}) and *t-1* ($s_{i,t-1}$) are defined by

$$s_{it} = \frac{\pi_{it}^{nom} m_{it}^{real}}{y_t} \text{ and } s_{i,t-1} = \frac{\pi_{i,t-1}^{nom} m_{i,t-1}^{real}}{y_{t-1}} .$$

The real monetary services index has the same theoretical interpretation and statistical properties as the quantity or real output indices currently produced by the Commerce Department, such as Gross Domestic Product (GDP), see for example Triplett (1992).[5]

The opportunity cost of monetary services may be measured using an index number dual to the MSI. Total nominal expenditures on monetary assets (and therefore on monetary services), denoted above as y_t, equals the sum of all monetary asset stocks multiplied by their corresponding user costs. Using this definition, the nominal user cost index dual to the real MSI is defined implicitly using Fisher's equation known as weak factor reversal (see Fisher, 1922),

$$\Pi_t^{nom} = \Pi_{t-1}^{nom} \cdot \left(\frac{y_t / y_{t-1}}{MSI_t^{real} / MSI_{t-1}^{real}} \right).$$

Because it is dual to the real MSI, the nominal user cost index may be included in general models of the demand for goods and services as the "price" of real monetary services. It is dual to the monetary service flow in the same way that the GDP deflator is dual to GDP.

Values of the real MSI and it dual user cost index can be used in the estimation of demand functions for the flow of monetary services because they are consistent with the underlying economic theory. Simple sum aggregates such as real M1 and real M2 have been used in the past in the estimation of "money demand"; however the simple sum aggregates are not connected to microeconomic optimization theory and demand functions estimated for them are not generally consistent with economic demand theory based on optimizing behavior. See Anderson, Jones, and Nesmith (1997) for a detailed discussion.

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[5] Specifically, the current Commerce Department real quantity indices are chained superlative (Fisher Ideal formula) indices, and the real MSI indices are chained superlative (Törnqvist-Theil formula) indices.

THE ST. LOUIS MONETARY SERVICES INDICES

This section describes the indices in the new database. The reader is cautioned that it is necessary to distinguish carefully in this section between *nominal* and *real* stocks of monetary assets. The issue is important because monetary data collected by the Federal Reserve are in *nominal* terms but monetary aggregation and statistical index number theory provide conditions for combining stocks of *real* monetary assets (see for example Barnett, 1978, 1980, 1987, 1990 and Anderson, Jones and Nesmith 1997). We discuss the importance of this issue and provide some necessary guidance to the user throughout the section.

The fact that monetary data are collected in nominal terms requires some extension of monetary aggregation and statistical index number theory. Let m_{it}^{nom} be the nominal stock of asset i, in period t. By definition, nominal and real asset stocks are related (using the true economic cost of living index, p_t^*) by

$$m_{it}^{real} = \frac{m_{it}^{nom}}{p_t^*}.$$ [6]

We can also deflate the nominal user costs to produce real user costs. Define the real user cost of monetary asset i in period t by

$$\pi_{it}^{real} = \frac{R_t - r_{it}}{1 + R_t}.$$

We note that nominal expenditures on monetary services, y_t, can be rewritten as

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[6] In reality the true economic cost of living index is unknown and must be approximated. This can be done using a superlative price index, which can provide a second order approximation of the true economic cost of living index. In the discussion which follows, we assume the equality holds. This is equivalent to knowing the true economic cost of living index exactly. In continuous time, a Divisia price index will be exact and this equality holds, in the discrete time case it holds up to the second order.

$$y_t = \sum_{i=1}^{n} \pi_{it}^{nom} m_{it}^{real} = \sum_{i=1}^{n} p_t^* \pi_{it}^{real} \frac{m_{it}^{nom}}{p_t^*} = \sum_{i=1}^{n} \pi_{it}^{real} m_{it}^{nom} .$$

This demonstrates that the adding-up condition still holds (the sum of all individual nominal monetary asset stocks multiplied by their corresponding real user costs equals nominal expenditures on monetary services). In addition, it shows that the expenditure shares do not depend on the true economic cost of living index, p_t^* . In fact, the shares can be shown to equal

$$s_{it} = \frac{(R_s - r_{is}) m_{is}^{real}}{\sum_{j=1}^{n} (R_s - r_{js}) m_{js}^{real}} = \frac{(R_s - r_{is}) m_{is}^{nom}}{\sum_{j=1}^{n} (R_s - r_{js}) m_{js}^{nom}} .$$

The expenditure shares can equivalently be viewed as the expenditure share on real assets based on nominal user costs, or as the expenditure share on nominal assets based on real user costs.

The nominal (Törnqvist-Theil) monetary services index, MSI_t^{nom} is defined as

$$MSI_t^{nom} = MSI_{t-1}^{nom} \prod_i \left(\frac{m_{it}^{nom}}{m_{i,t-1}^{nom}} \right)^{\bar{s}_{it}} .$$

Because the expenditure shares may be interpreted either as nominal or real expenditure shares, this formula is simply the usual Törnqvist-Theil index number formula applied to nominal stocks, rather than real stocks. This index has often been referred to as a Divisia monetary aggregate, because of its relation to the continuous time Divisia index.

We can implicitly define a real user cost index dual (in the sense that it satisfies Fisher's weak factor reversal test) to the nominal Törnqvist-Theil monetary services index, Π_t^{real} , as

$$\Pi_t^{real} = \Pi_{t-1}^{real} \cdot \left(\frac{y_t / y_{t-1}}{MSI_t^{nom} / MSI_{t-1}^{nom}} \right) .$$

The relationship between Törnqvist-Theil real and Törnqvist-Theil nominal monetary services indices and their corresponding dual user cost indices is:

$$\Delta\, log(\frac{MSI_t^{Nom}}{p_t^*}) = \Delta\, log(MSI_t^{real})$$

$$\Delta\, log(\Pi_t^{real}) = \Delta\, log(\frac{\Pi_t^{nom}}{p_t^*}),$$

where "*log*" denotes base *e* natural logarithms.[7] We can therefore produce the real Törnqvist-Theil monetary services index by aggregating over nominal stocks to produce the nominal Törnqvist-Theil monetary services index and then deflating this aggregate. The duals may be constructed similarly.

The St. Louis MSI database includes the nominal Törnqvist-Theil monetary services index and the dual real user cost index. The nominal Törnqvist-Theil monetary services index may be deflated to produce its real counterpart, but the choice of deflator is left up to the user because the appropriate deflator may depend on the model being estimated. In general, the chosen price index should correspond to the price aggregate that is dual to the quantity aggregate of another block of weakly separable decision variables in the model being estimated. There is a large set of price indices that may or may not be appropriate in specific applications, including the CPI, the GDP deflator, and the PCE deflator. It may also be possible to deflate the indices using a measure of the real wage rate. *Caveat emptor.* In the remainder of this section, we discuss the additional indices in the MSI database.

We can interpret two other commonly used monetary indices in an aggregation theory framework: the currency equivalent (CE) index (see Rotemberg, Driscol, and Poterba, 1995 and Rotemberg, 1991) and the simple sum monetary aggregate (as published by the Federal Reserve

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[7] If the true economic cost of living index is replaced by a Divisia index number then the equalies are true up to a third order error in discrete time, and exactly true in continuous time. If a different price index is used to track the true economic cost of living index then the equality will be true only up to the tracking ability of the index which is used.

Board). Although both of these indices are inferior to the Törnqvist-Theil monetary services index as measures of the *flow* of monetary services (see Barnett, 1980, 1991), the aggregation suggests interesting interpretations as *stock* concepts.

As above, let y_t represents the agent's nominal expenditures on monetary services in period t. If the consumer expects to spend the same amount on monetary services during each future period (or in other words, the agent had static expectations) and if the agent discounts at the benchmark rate of return, then the discounted present value of all current and expected future nominal expenditures on monetary services is equal to the CE index, which is defined as

$$CE_t = \sum_{i=1}^{n} \frac{R_t - r_{it}}{R_t} m_{it}^{nom} .$$

(see Barnett, 1991). Under the same static expectations assumption, the simple sum index, defined by

$$SS_t = \sum_{i=1}^{n} m_{it}^{nom}$$

can be shown to equal the discounted present value of the expected investment yields on current and expected future holdings of monetary assets *plus* the CE index. Thus, the simple sum index can be interpreted as the discounted present value of current and expected future expenditures on monetary services plus the discounted present value of all current and expected future investment yields from holding monetary assets, which may be quite far from the value of an index of the quantity of monetary services purchased by an economic agent. Consequently, estimated demand functions for the CE index or the simple sum index would not be consistent with the theory used in this paper.

As noted in Anderson, Jones and Nesmith (1997), the Törnqvist-Theil statistical index number is not self dual. The general relationship between Törnqvist-Theil price and quantity index numbers was established by Theil (1967). With regard to monetary aggregation, we can define the Törnqvist-Theil real user cost index, UC_t^{real}, as

$$UC_t^{real} = UC_{t-1}^{real} \prod_{i=1}^{n} \left(\frac{\pi_{it}^{real}}{\pi_{i,t-1}^{real}} \right)^{\bar{s}_{it}} .$$

Theil's (1967) result applied to monetary indices shows that

$$\Delta \log(MSI_t^{nom}) + \Delta \log(UC_t^{real}) = \Delta \log(y_t) + \Delta \log(S_t),$$

where S_t is a Törnqvist-Theil expenditure share index, defined by

$$S_t = S_{t-1} \prod_{i=1}^{n} \left(\frac{s_{it}}{s_{i,t-1}} \right)^{\bar{s}_{it}} .$$

In addition, Theil (1967) defined four indices known as Divisia second moments: the Divisia quantity growth rate variance, Divisia user cost growth rate variance, Divisia expenditure share growth rate variance, and the Divisia quantity / user cost growth rate covariance.[8]

A series of tests for the failure of the two principal assumptions of monetary aggregation theory – a representative agent and (homothetic) weak separability – have been proposed by Barnett and Serletis (1990) using the Divisia second moments. Because the tests rely on the dispersion (differences among) the growth rates of the individual monetary asset stocks, user costs, or expenditure shares, they are referred to as *dispersion dependency tests*. In addition to testing for violations of the aggregation assumptions, these tests also may reveal changes in the amount of monetary services received by economic agents from a bundle of monetary assets during periods of regulatory change. Examples of the latter include the phased removal of Regulation Q ceilings on depository institutions' offering rates between 1978 and 1986, and the

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[8] The definitions of these indices are contained in Table 1a, at the end of this section.

introduction of new types of deposits such as All-Savers certificates in 1978 and money market deposit accounts in 1982.

Although not discussed by Barnett and Serletis (1990), the *dispersion dependency tests* resemble in spirit Ramsey's RESET specification error test (see Ramsey, 1969). In Ramsey's test, the set of explanatory variables in a regression is augmented by the inclusion of powers of the original explanatory variables (squares, cubes, etc.). The test is based on the intuition that specification errors in a regression, such as incorrect functional form or omission of relevant variables, are likely to produce a set of residuals that are correlated with higher moments of the included variables. Because the exact form of any correlation is unspecified, the alternative hypothesis is very diffuse ("something is wrong with the regression") and the test might be expected to have low power. Extensive Monte Carlo experiments suggest that, in fact, it has substantial power against a wide range of specification errors (see Thursby, 1979; Thursby and Schmidt, 1977). The situation is somewhat better in the case of monetary aggregation, because violations of aggregation assumptions suggest specific quadratic (and perhaps higher order) terms.

Empirical results using dispersion dependency tests are presented in Barnett and Serletis (1990) and Barnett, Jones, and Nesmith (1995,1996). The evidence in these studies for U.S. monetary data suggests that, for at least some time periods, movements in the various data are not consistent with the movements that would be implied by a representative agent with a weakly separable utility function. In this case, Barnett and Serletis (1990) suggest that including Divisia second moments in macroeconomic models might provide a correction for the aggregation error. For further discussion, see Anderson, Jones and Nesmith (1997).

All indices discussed in this section are contained in the database. For the reader's convenience we summarize the definitions of all the indices in the database in Table 1, and Table 1a.

Table 1

Summary of Indices in the New Database

Nominal Expenditures on Monetary Services	$y_t = \sum_{i=1}^{n} \pi_{it}^{real} m_{it}^{nom}$
Nominal (Törnqvist-Theil) Monetary Services Index	$MSI_t^{nom} = MSI_{t-1}^{nom} \prod_{i=1}^{n} (\frac{m_{it}^{nom}}{m_{i,t-1}^{nom}})^{\bar{s}_{it}}$
Real User Cost Index Dual to the nominal (Törnqvist-Theil) MSI	$\Pi_t^{real} = \Pi_{t-1}^{real} \frac{(y_t / y_{t-1})}{(M_t^{nom} / M_{t-1}^{nom})}$
Currency Equivalent (CE) Index [a]	$CE_t = \sum_{i=1}^{n} \frac{R_t - r_{it}}{R_t} m_{it}^{nom}$
Simple Sum Index [b]	$SS_t = \sum_{i=1}^{n} m_{it}^{nom}$

[a] See Rotemberg, Driscol, and Poterba (1995), Rotemberg (1991), Barnett (1991), and Anderson, Jones and Nesmith (1997) for discussions of this index.

[b] See Barnett (1991), and Anderson, Jones and Nesmith (1997) for discussions of this index.

Table 1a

Summary of the Divisia Second Moments and Related Indices in the Database

Nominal (Törnqvist-Theil) Monetary Services Index	$MSI_t^{nom} = MSI_{t-1}^{nom} \prod_{i=1}^{n} (\frac{m_{it}^{nom}}{m_{i,t-1}^{nom}})^{\bar{s}_{it}}$
Real (Törnqvist-Theil) User Cost Index[a]	$UC_t^{real} = UC_{t-1}^{real} \prod_{i=1}^{n} (\frac{\pi_{it}^{real}}{\pi_{i,t-1}^{real}})^{\bar{s}_{it}}$
Törnqvist-Theil Expenditure Share Index[a]	$S_t = S_{t-1} \prod_{i=1}^{n} (\frac{s_{it}}{s_{i,t-1}})^{\bar{s}_{it}}$
Divisia Quantity Growth Rate Variance[a]	$K_t = \sum_{i=1}^{n} \bar{s}_{it} [\Delta log(m_{it}^{nom}) - \sum_{i=1}^{n} \bar{s}_{it} \Delta log(m_{it}^{nom})]^2$
Divisia User Cost Growth Rate Variance[a]	$J_t = \sum_{i=1}^{n} \bar{s}_{it} [\Delta log(\pi_{it}^{real}) - \sum_{i=1}^{n} \bar{s}_{it} \Delta log(\pi_{it}^{real})]^2$
Divisia Expenditure Share Growth Rate Variance[a]	$\Psi_t = \sum_{i=1}^{n} \bar{s}_{it} [\Delta log(s_{it}) - \sum_{i=1}^{n} \bar{s}_{it} \Delta log(s_{it})]^2$
Divisia Quantity / User Cost Growth Rate Covariance[a]	$\Gamma_t = \sum_{i=1}^{n} \bar{s}_{it} [(\Delta log(\pi_{it}^{real}) - \sum_{i=1}^{n} \bar{s}_{it} \Delta log(\pi_{it}^{real})) \cdot (\Delta log(m_{it}^{nom}) - \sum_{i=1}^{n} \bar{s}_{it} \Delta log(m_{it}^{nom}))]$

[a] See Theil (1967), Barnett and Serletis (1990), Barnett, Jones and Nesmith (1995,1996), and Anderson, Jones and Nesmith (1997) for discussions of this index. Theil (1967) proved that $\Delta log(MSI_t^{nom}) + \Delta log(UC_t^{real}) = \Delta log(y_t) + \Delta log(S_t)$ and that the covariance can be defined implicitly as $\Gamma_t = (\Psi_t - K_t - J_t)/2$.

THE ASSET STOCK DATA AND THE LEVELS OF AGGREGATION

In this section of the paper, we describe the asset stock data in detail and discuss the levels of aggregation of the indices in the database. Discussion of the own rate data and related methodology is deferred until the following section.

The official simple sum aggregates produced by the Federal Reserve Board are constructed over a set of monetary asset stocks at four nested levels of aggregation: M1, M2, M3, and L. In addition to these levels of aggregation, some economists have advocated two other levels of aggregation, M1A and MZM. M1A consists of the monetary assets in M1 which do not earn an explicit rate of return. MZM conceptually corresponds to monetary assets in M2 which do not have a fixed maturity.[9]. All of these levels of aggregation are summarized in Table 2

Table 2

Components of Monetary Indices by Official Levels of Aggregation

M1A	**Non M1 Assets in MZM**	**Non M2 Assets in M3**	**Non M3 Assets in L**
Currency	Money Market Deposit Accounts	Total Repurchase Agreements	Savings Bonds
Travelers' Checks	Savings Deposits	Total Eurodollars	Short Term Treasury Securities
Demand Deposits	Retail Money Funds	Large Denomination Time Deposits	Bankers Acceptances
		Institutional Money Funds	Commercial Paper
Non M1A Assets in M1	**Non MZM Assets in M2**		
Other Checkable Deposits	Small Denomination Time Deposits		
Super Now Accounts			

[9] MZM was originally defined by William Poole, who labelled it "zero maturity money" and included institution-only money market mutual funds. The latter are excluded here because they do not follow the same accounting rules as retail money market funds (including daily mark-to-market and penny rounding), and because under SEC rules these funds are marketed only to larger investors.

Some economists have recently suggested that monetary indices should contain a broader set of components, including some capital uncertain liquid assets such as bond and equity mutual funds (see Collins and Edwards, 1994, and Orphanides, Reid, and Small, 1994). The theoretical procedures used in the construction of the St. Louis MSI database are valid only under the assumption of risk neutrality. Extension of the aggregation procedures to include risky (capital uncertain) assets such as stock and bond funds requires reformulating the aggregation theory under the more general case of risk aversion and subtracting a risk premia from the monetary asset user costs, see Barnett and Liu (1995). This is a topic for future research.

The St. Louis MSI database contains monetary services indices constructed over the same sets of assets (levels of aggregation) as the simple sum monetary aggregates M1A, M1, MZM, M2, M3, and L. We do not test for the weak separability of each group of included monetary assets from other assets or goods. In principle, the correct level of aggregation of monetary assets should be determined by tests for weak separability.[10] Several studies have rejected the weak separability of the assets included in M1, M2, M3, and L; see for example Swofford and Whitney (1987, 1988) and Belongia (1995).[11] More recently, Swofford and Whitney (1994) have noted that relaxation of the assumption of continuous complete portfolio adjustment maintained in derivation of the MSI aggregator functions significantly complicates separability testing; see also Spencer (1994). Testing the separability of the included assets is a topic for future research; users are encouraged to conduct their own tests using the disaggregated data provided in the database.

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[10] A weakly separable block could contain both monetary assets and consumption goods, but an aggregate formed over such a block would not usually be interpretted as a monetary service flow.

[11] Weak separability is also rejected in a well-known paper by Belongia and Chalfant (1989). Note, however, that their tests are conducted in nominal rather than real terms, invalidating the results of the tests.

The asset stock data used to produce the indices in the database are shown in Table 3. The database contains the asset stock data in both seasonally adjusted and unadjusted form, with the exceptions of the non-M3 components of L and of super NOW accounts at both commercial banks and at thrift institutions. Most data were originally published in the Federal Reserve Board's H.6. statistical release, and have been later revised by Board staff. For discussion, see the H.6 release or Anderson and Kavajecz (1994).

The data in Table 3 are reported at the most disaggregate level feasible.[12] As a result, some assets appear for shorter time periods than others. Super NOW accounts have been separated from other checkable deposits over the period in which disaggregated data are available, 1993.01-1995.12. Similarly, savings deposits and money market deposit accounts have been separated during the period 1960.01-1991.08 when separate data were collected. In addition, the following asset categories are separated into thrift institution and commercial bank categories: other checkable deposits, super NOW accounts, small denomination time deposits, savings deposits and money market deposit accounts. There are two exceptions to this principle. The first is that term and overnight eurodollar and repurchase agreements are combined into total eurodollars and total repurchase agreements, and the second is that large denomination time deposits are not separated into commercial bank and thrift institution categories.[13]

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[12] The criterion for feasibility is that disaggregated data for the desired asset stock must be available and of good quality. In addition, reliable own rate data for the category must exist.

[13] The first exception is motivated by arguments in Whitesell and Collins (1996). Prior to 1996, the Federal Reserve Board staff included overnight repurchase agreements and Eurodollar deposits in the non-M1 component of M2, and included term repurchase agreements and Eurodollar deposits in the non-M2 portion of M3. Currently, repurchase agreements and Eurodollars are included only in the non-M2 component of M3 (and in L, which includes all of M3). The MSI indices are extremely robust to how repurchase agreements and Eurodollars are included in the M2 and M3 MSI. Large time deposits are discussed further below in the section on user cost construction.

Table 3: Asset Stock Data

Monetary Assets	Sample Period
M1A Assets	
Currency	1960.01-present
Travelers' Checks	1960.01-present
Demand Deposits	1960.01-present
Non M1A Assets in M1	
Other Checkable Deposits at Commercial Banks Net of Super NOW Accounts[a]	1974.01-1985.12
Other Checkable Deposits at Thrift Institutions Net of Super NOW Accounts[b]	1960.01-1985.12
Super Now Accounts at Commercial Banks[c]	1982.12-1985.12
Super Now Accounts at Thrift Institutions[d]	1982.12-1985.12
Other Checkable Deposits at Commercial Banks Including Super NOW Accounts[a]	1986.01-present
Other Checkable Deposits at Thrift Institutions Including Super NOW Accounts[b]	1986.01-present

[a] We subtract Super Now Accounts at Commercial Banks from Other Checkable Deposits at Commercial Banks during the period 1982.12-1985.12. Quantity data for Other Checkable Deposits at Commercial Banks prior to 1974.01 is insignificant.

[b] We subtract Super Now Accounts at Thrift Institutions from Other Checkable Deposits at Thrift Institutions during the period 1982.12-1985.12.

[c] After 1985.12, Super Now Accounts at Commercial Banks are included in Other Checkable Deposits at Commercial Banks. We do not seasonally adjust this category.

[d] After 1985.12, Super Now Accounts at Thrift Institutions are included in Other Checkable Deposits at Thrift Institutions. We do not seasonally adjust this category.

[a] We subtract Super Now Accounts at Commercial Banks from Other Checkable Deposits at Commercial Banks during the period 1982.12-1985.12.

[b] We subtract Super Now Accounts at Thrift Institutions from Other Checkable Deposits at Thrift Institutions during the period 1982.12-1985.12.

Table 3 Continued

Monetary Assets	Sample Period
Non-M1 Assets in MZM	
Money Market Deposit Accounts at Commercial Banks[e]	1982.12-1991.08
Money Market Deposit Accounts at Thrift Institutions[f]	1982.12-1991.08
Savings Deposits at Commercial Banks Net of Money Market Deposit Accounts[g]	1960.01-1991.08
Savings Deposits at Thrift Institutions Net of Money Market Deposit Accounts[h]	1960.01-1991.08
Savings Deposits Including Money Market Deposit Accounts at Commercial Banks	1960.01-present
Savings Deposits Including Money Market Deposit Accounts at Thrift Institutions	1960.01-present
Retail Money Funds	1973.02-present
Non MZM Assets in M2	
Small Denomination Time Deposits at Commercial Banks	1960.01-present
Small Denomination Time Deposits at Thrift Institutions	1960.01-present

[e] After 1991.08, the Federal Reserve did not report Money Market Deposit Accounts at Commercial Banks as a separate component. Money Market Deposit Accounts are now combined with Savings Deposits at Commercial Banks into a composite category.

[f] After 1991.08, the Federal Reserve did not report Money Market Deposit Accounts at Thrift Institutions as a separate component. Money Market Deposit Accounts are now combined with Savings Deposits at Thrift Institutions into a composite category.

[g] After 1991.08, the Federal Reserve did not report Savings Deposits at Commercial Banks as a separate component. Savings Deposits at Commercial Banks are now combined with Money Market Deposit Accounts at Commercial Banks into a composite category.

[h] After 1991.08, the Federal Reserve did not report Savings Deposits at Thrift Institutions as a separate component. Savings Deposits at Thrift Institutions are now combined with Money Market Deposit Accounts at Thrift Institutions into a composite category.

Table 3 Continued

Non-M2 Assets in M3	
Total Repurchase Agreements[i]	1960.01-present
Total Eurodollars[j]	1960.01-present
Total Large Denomination Time Deposits	1960.01-present
Institutional Money Funds	1960.01-present
Non-M3 Assets in L	
Savings Bonds	1960.01-present
Short Term Treasury Securities	1960.01-present
Bankers Acceptances	1960.01-present
Commercial Paper	1960.01-present

THE OWN RATE DATA

The user costs of monetary assets are constructed from the own rates of return of the various monetary assets.[14] In this section, we provide a detailed discussion of the own rate data. There are six subsections, in which we discuss sources of the own rate data and proxies for missing values, measures of the implicit rate of return on demand deposits, regulated ceiling rates, the market interest rate for savings bonds, own rate conversion, and yield curve adjustment.[15]

[i] Total Repurchase Agreements includes both term and overnight accounts. See Whitesell and Collins (1996) for a discussion of this category. Prior to 1996 overnight Repurchase Agreements were classified as an M2 asset, and term Repurchase Agreements were classified as an M3 asset.

[j] Prior to 1996 overnight Eurodollar Accounts were classified as an M2 asset, and term Eurodollar Accounts were classified as an M3 asset.

[14] The own rate series are used both directly and indirectly in the construction of user costs.

[15] Additional discussions of the data can be found in Barnett and Spindt (1982), Farr and Johnson (1985), Thornton and Yue (1991), and Belongia (1995).

The Own Rate Data in Detail

Table 4 lists the own rate data used to create the indices in the database and the sample periods over which the data are available. The sources of the data are presented in the footnotes. For some assets, quantity (stock) data are available for dates earlier than the initial observations on the corresponding own rates. In these cases, we regressed the asset's available own rate data for later periods on one or more closely related rates and used the fitted values from the regression as a proxy for the unavailable own rate data for earlier periods. The proxies are summarized in Table 5. Our proxies are robust to reasonable alternative regression specifications, perhaps because the spreads between similar assets change relatively slowly during most periods.

Table 4: Interest Rate Data

Interest Rate	Sample Period
Rate on Super NOW Accounts at Commercial Banks[a]	1983.10-1985.12
Rate on Super NOW Accounts at Thrift Institutions[a]	1983.10-1985.12
Rate on Money Market Deposit Accounts at Commercial Banks[a]	1983.10-1991.08
Rate on Money Market Deposit Accounts at Thrift Institutions[a]	1983.10-1991.08
Rate on NOW Accounts at Commercial Banks[b]	1986.01-present
Rate on NOW Accounts at Thrift Institutions[b]	1986.01-present
Rate on Savings Deposits and Money Market Deposit Accounts at Commercial Banks[b]	1986.04-present
Rate on Savings Deposits and Money Market Deposit Accounts at Thrift Institutions[b]	1986.04-present
7 to 91 Day Small Time Rate at Commercial Banks[b]	1983.10-present
92 to 182 Day Small Time Rate at Commercial Banks[b]	1983.10-present
183 Day to 1 Year Small Time Rate at Commercial Banks[b]	1983.10-present
1 to 2.5 Year Small Time Rate at Commercial Banks[b]	1983.10-present
2.5 Year Small Time Rate at Commercial Banks[b]	1983.10-present
7 to 91 Day Small Time Deposit Rate at Thrift Institutions[b]	1983.10-present
92 to 182 Day Small Time Deposit Rate at Thrift Institutions[b]	1983.10-present
183 Day to 1 Year Small Time Deposit Rate at Thrift Institutions[b]	1983.10-present
1 to 2.5 Year Small Time Deposit Rate at Thrift Institutions[b]	1983.10-present
2.5 Year Small Time Deposit Rate at Thrift Institutions[b]	1983.10-present

[a] Provided by the Federal Reserve Board. Originally published in the supplement to the Federal Reserve Board's H.6 Statistical Release. Data was published prior to 1983.10 but we have been unable to verify its accuracy.

[b] Provided by the Federal Reserve Board. Originally published in the supplement to the Federal Reserve Board's H.6 statistical release.

Table 4 Continued

Interest Rate	Sample Period
Rate on Other Savings at Commercial Banks[c]	1986.04-1991.08
Rate on Other Savings at Thrift Institutions[c]	1986.04-1991.08
Rate on Overnight Repurchase Agreements[d]	1972.02-present
Rate on Overnight Eurodollars[e]	1971.01-present
Rate on Federal Funds[f]	1960.01-present
One Month Rate on Commercial Paper[f]	1971.04-present
Three Month Rate on Commercial Paper[f]	1971.04-present
Six Month Rate on Commercial Paper[f]	1960.01-present
One Month Rate on Secondary Market Certificate of Deposits[f]	1965.12-present
Three Month Rate on Secondary Market Certificate of Deposits[f]	1964.06-present
Six Month Rate on Secondary Market Certificate of Deposits[f]	1964.06-present
One Month Rate on Term Eurodollars[f]	1971.01-present
Three Month Rate on Term Eurodollars[g]	1960.01-present
Six Month Rate on Term Eurodollars[h]	1963.05-present

[c] This data is part of the historical database for the supplement to the Federal Reserve Board's H.6 statistical release. It was provided to us by the Division of Monetary Affairs.

[d] Provided to us by the Federal Reserve Board.

[e] Provided by the Federal Reserve Board. Originally published in the Federal Reserve Board's H.13. statistical release.

[f] Provided by the Federal Reserve Board. Originally Published in the Federal Reserve Board's H.15 Statistical Release.

[g] From 1960.1 to 1970.12 this data is taken from Table I.a.1 page 148 of OECD Financial Statistics (1976). From 1971.1 to present this data was originally published in the Federal Reserve Board's H.15 Statistical Release.

[h] From 1963.5 to 1970.12 this data is taken from Table I.b.1 page 150 of OECD Financial Statistics (1976). From 1971.1 to present this data was originally published in the Federal Reserve Board's H.15 Statistical Release.

Table 4 Continued

Interest Rate	Sample Period
One Month Secondary Market Treasury Bill Rate[d]	1968.01-present
Three Month Secondary Market Treasury Bill Rate[f]	1960.01-present
Six Month Secondary Market Treasury Bill Rate[f]	1960.01-present
One Year Treasury Constant Maturities Rate[f]	1960.01-present
Two Year Treasury Constant Maturities Rate[f]	1976.06-present
Three Year Treasury Constant Maturities Rate[f]	1960.01-present
Five Year Treasury Constant Maturities Rate[f]	1960.01-present
Three Month Auction Average Treasury Bill Rate[f]	1960.01-1983.12
Six Month Auction Average Treasury Bill Rate[f]	1960.01-1983.12
One Year Auction Average Treasury Bill Rate[f]	1960.01-1983.12
Rate on Money Market Mutual Funds[d]	1974.06-present
Rate on BAA Bonds[f]	1960.01-present
Investment Yields to Maturity for Series E Savings Bonds[i]	1960.01-1982.10
Three Month Rate on Bankers Acceptances[j]	1960.01-1972.12
Three Month Rate on Bankers Acceptances[f]	1973.01-present
Six Month Rate on Bankers Acceptances[f]	1976.01-present

[i] This data was provided to us by the Savings Bond Operations Office, Department of Treasury. The data is also published through 1979 in Brennan and Schwartz (1979).

[j] The 3 month Bankers' Acceptance rate is the 90 Day Prime Bankers' Acceptance rate from Table 12.5 from Banking and Monetary Statistics 1941-1970.

Table 5

Proxies of Own Rates

All Rates are Adjusted to an Annualized One Month Yield on a Bond Interest Basis

Dependent Variable (Y)	**Independent Variable (X)**	**Proxy Period**	**Estimated Regression** Y = a + bX		
			a	**b**	**Estimation Sample Period**
Super NOW Account Rate at Commercial Banks[a]	One Month Secondary Market Treasury Bill Rate	1982.12-1983.09	2.88 (.000)	.52 (.000)	1983.10-1985.12
Super NOW Account Rate at Thrift Institutions[a]	One Month Secondary Market Treasury Bill Rate	1982.12-1983.09	3.67 (.000)	.44 (.000)	1983.10-1985.12
Rate on Money Market Funds[b]	Overnight Federal Funds Rate	1973.02-1974.05	.67 (.002)	.85 (.000)	1974.10-1983.12
Rate on Money Market Deposit Accounts at Commercial Banks[a]	One Month Secondary Market Treasury Bill Rate	1982.12-1983.09	1.20 (.001)	.78 (.000)	1983.10-1991.08
Rate on Money Market Deposit Accounts at Thrift Institutions[a]	One Month Secondary Market Treasury Bill Rate	1982.12-1983.09	1.44 (.000)	.80 (.000)	1983.10-1991.08
Overnight Repurchase Agreement Rate	Overnight Federal Funds Rate	1969.10-1972.01	.25 (.001)	.92 (.000)	1972.02-1983.12
One Month Secondary Market Treasury Bill Rate	3 Month Secondary Market Treasury Bill Rate	1960.1-1967.12	.06 (.279)	.95 (.000)	1968.01-1983.12

The Implicit Rate of Return on Demand Deposits

In order to construct a user cost for demand deposits, we need to specify an own rate for demand deposits. The appropriate own rate for demand deposits has been widely debated among

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[a] Own rate data was published prior to 1983.10 but we have been unable to verify its accuracy.

economists. Although most financial institution pay both explicit and implicit interest on deposits (the latter perhaps in free services or easier access to credit), demand deposits are unique because depositories are legally prohibited from paying explicit interest on these deposits. Many economists have suggested that non-price competition has allowed depositories to effectively evade, at least in part, the prohibition of explicit interest on demand deposits. Startz (1979) focuses on three competing hypotheses: the "traditional" hypothesis, which maintains that the prohibition on interest paid to demand deposits was fully effective; the "competitive" hypothesis, which maintains that the prohibition of interest on demand deposits is completely ineffective; and the modified competitive hypothesis, which maintains that the prohibition was partially effective.

An expression for the fully competitive implicit rate of return on demand deposits was derived by Klein (1974). An implicit rate of return for demand deposits can be defined by assuming that banks earn no profit on demand deposits, and that banks face perfectly competitive markets. Thus,

$$r_A - r_D = MC_D,$$

where r_D is the implicit interest rate on demand deposits, r_A is the interest rate on an alternative asset, and MC_D is the marginal cost of producing demand deposits. Under additional assumptions, Klein shows that this is equivalent to

$$r_D = (1 - c)r_A,$$

where c is the ratio of reserves to deposits. Startz (1979) advocates a modified competitive hypothesis. He argues, using functional cost data, that the implicit demand deposit rate has been

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[b] Farr and Johnson (1985) and Thornton and Yue (1992) proxy this series using the large denomination time deposit rate. We found that our proxy was superior.

positive, well below the fully competitive Klein rate, and responsive to market interest rates.[16] Empirical evidence on the various hypotheses has been mixed, see for example Rush (1980), Carlson and Frew (1980), Allen (1983), and Rossiter and Lee (1987).

In previous constructions of index number theoretic monetary aggregates, the implicit fully competitive Klein rate has been used for business demand deposits and it has been assumed that the prohibition of interest on demand deposits is fully effective for households. The interest rate on the alternative asset was assumed to be the one month commercial paper rate. In Farr and Johnson (1985) and Thornton and Yue (1992), the distinction between household and business demand deposits was based on the Demand Deposit Ownership Survey (Board of Governors, 1971-1991). Collection of that survey data has been discontinued, and thus we cannot base our construction on the previous methodology.

We advocate the modified competitive hypothesis applied to all demand deposits. Startz (1979) has argued that the implicit rate of return on demand deposits is between .34 and .58 times the fully competitive Klein rate using five year treasury notes as the own rate on the alternative asset. Thus, the implicit rate of return on demand deposits is proxied as,

$$r_D = (1-\tau)(r_A)\cdot(\alpha),$$

where r_A is the rate on five year treasury notes, τ is (an estimate of) the maximum reserve requirement on demand deposits, and α is between .34 and .58. We have chosen α to be .58.[17] In Table 6, we detail our construction of a maximum reserve requirement series for demand deposits. The assumptions used to construct an implicit rate of return for demand deposits are

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[16] For a discussion of other implicit return series see Becker (1975) and Barro and Santomero (1972).

[17] We defer to the section of the paper on the construction of user costs for the reasoning behind this choice.

not empirically trivial (or in other words, they can have large effects on the MSI). The appropriate treatment of this issue is an area for further research.

Table 6

Reserve Requirement Ratios

Percentage Maximum Reserve Requirement for Demand Deposits	**Date**
16.25[a]	1960.01 - 1967.12
17.00[a]	1968.01 - 1969.03
17.50[b]	1969.04 - 1973.06
18.00[b]	1973.07 - 1974.11
17.50[b]	1974.12 - 1975.01
16.50[c]	1975.02 - 1976.12
16.25[c]	1977.01 - 1980.10
12.00[d]	1980.11 - 1992.11
10.00[d]	1992.12 - present

Regulated Ceiling Rates

Own rates of return on monetary assets have been subject to rate ceilings over the sample period of the asset stock data. Consequently, we construct ceiling rate data in order to produce

[a] This is the reserve requirement ratio on net demand deposits at reserve city banks from Table 10.4 in Banking and Monetary Statistics, 1941-1970 (1976).

[b] This is the reserve requirement ratio on net demand deposits over $5 million at Reserve City Banks from Table 7. in the Annual Statistical Digest, 1971-1975 (1981).

[c] This is the reserve requirement ratio on net demand deposits over $400 million from Table 6. in the Annual Statistical Digest, 1970-1979 (1981).

[d] From 1980.11 to 1990.11, this is the reserve requirement ratio on net transaction accounts at depository institutions after the implementation of the Monetary Control Act of 1980 from Table 6. in the Annual Statistical Digest, 1980-1989 (1991). In 1980-1981, this is the requirement for net transactions accounts more than $25 million. In 1982-1983, this is the requirement for net transactions accounts more than $26 million. In subsequent years, it is the larger of the two categories for net transactions accounts as the $26 million breakpoint grows each year. From 1990.12 to the present, this is the reserve requirement ratio on net transaction accounts in the larger category at depository institutions after the implementation of the Monetary Control Act of 1980 from Table 6. in each year's Annual Statistical Digest (1991, 1992, 1993, 1994, 1995).

the user costs for regulated monetary assets. In this section, we describe the data for periods with fixed ceiling rates and describe our construction of data for periods with variable ceiling rates.

Negotiable orders of withdrawal (NOW) accounts are a type of checkable deposit, currently included in the Federal Reserve's M1 monetary aggregate. Commercial banks and thrift institutions in Massachusetts and New Hampshire were allowed to offer NOW accounts in 1974.01. NOW accounts were allowed in all of New England beginning in 1976.02, New York state in 1978.11, and in New Jersey in 1979.12. In 1980.12 NOW accounts were authorized nationally. The own rates of return on NOW accounts at commercial banks and thrift institutions were subject to ceiling rates beginning in 1974.01. The ceiling rates for NOW accounts are summarized in Table 7.

Table 7 Fixed Ceiling Rates on NOW Accounts

Asset Category	**Ceiling Rate**	**Effective Date**
NOW accounts at Commercial Banks[a]	5.00	1974.01-1980.12
	5.25	1981.01-1985.12
NOW accounts at Thrift Institutions[b]	5.00	1974.01-1980.12
	5.25	1981.01-1985.12

[a] See Table 8A of the Annual Statistical Digest (1970-1979), and Table 8 Annual Statistical Digest (1980,1981,1982,1983,1984,1985,1986).

[b] See Table 8B of the Annual Statistical Digest (1970-1979), and Table 8 Annual Statistical Digest (1980,1981,1982,1983,1984,1985,1986).

Savings deposits have also been subject to fixed ceiling rates. In Table 8, we summarize the fixed ceiling rates on savings deposits at commercial banks and thrift institutions.

Table 8 Fixed Ceiling Rates on Savings Deposits

Asset Category	Ceiling Rate	Effective Date
Savings Deposits at Commercial Banks	3.00	1960.01-1961.12[a]
	3.50	1962.01-1964.11[a]
	4.00	1964.12-1970.01[b]
	4.50	1970.02-1973.06[c]
	5.00	1973.07-1979.06[c]
	5.25	1979.07-1983.12[c]
	5.50	1984.01-1986.03[c]
Savings Deposits at Thrift Institutions	5.00	1970.01-1973.06[d]
	5.25	1973.07-1979.06[d]
	5.50	1979.07-1986.03[d]

Small denomination time deposits have been subject to fixed ceiling rates and variable ceiling rates that were tied to market interest rates. We have constructed two fixed rate series: the fixed ceiling rates on three month small denomination time deposits, and the fixed ceiling rates on one year small denomination time deposits. These rates actually applied to deposits with varying ranges of maturities, and so we caution the reader regarding the precise interpretation of these series. We assume that large time deposits earn various certificate of deposit rates, however this methodology cannot be used prior to 1964.06, due to lack of data. Because of this,

[a] This is the fixed ceiling rate on savings deposits held for less than 1 year. See Table 12.4A Banking and Monetary Statistics (1941-1970).

[b] This is the fixed ceiling rate on savings deposits held for less than 1 year until July 20, 1966, after which it is simply savings deposits. See Table 12.4A Banking and Monetary Statistics (1941-1970).

[c] See See Table 8A of the Annual Statistical Digest (1970-1979), and Table 8 Annual Statistical Digest (1980,1981,1982,1983,1984,1985,1986)

[d] See Table 8B of the Annual Statistical Digest (1970-1979), and Table 8 Annual Statistical Digest (1980,1981,1982,1983,1984,1985,1986).

we need to construct a ceiling rate for 6 month large time deposits, based on the assumption that ceiling rates were generally binding during this period. This assumption seems to be valid based on existing research at the time, see for example Federal Reserve Bulletin April 1963, June 1963, February 1964, and May 1964. In Table 9, we summarize the fixed ceiling rates that applied to various maturity small time deposits at commercial banks, prior to the introduction of variable ceiling rates, and the fixed ceiling rate on 6 month large time deposits. The footnotes contain additional details.

Table 9 Fixed Ceiling Rates on Time Deposits

Asset Category	Ceiling Rate	Effective Date
3 Month Small Denomination Time Deposits	1.00	1960.01-1964.11[a]
	4.00	1964.12-1965.11[a]
	5.50	1965.12-1966.07[a]
	5.00	1973.07-1978.05[b]
1 Year Small Denomination Time Deposits	3.00	1960.01-1961.12[c]
	3.50	1962.01-1963.07[c]
	4.00	1963.08-1964.11[c]
	4.50	1964.12-1965.11[c]
	5.50	1965.12-1966.09[d]
	5.00	1966.10-1973.06[e]
	5.50	1973.07-1978.05[f]
6 Month Ceiling rate on Large Time Deposits	2.50	1960.01-1963.07[g]
	4.00	1963.08-1964.05[g]

With the introduction of money market time deposits in 1978.06, some small time deposits were subject to variable ceiling rates which were tied to market interest rates.[18] We

[a] This is the fixed ceiling rate on other time deposits payable in less than 90 days. See Table 12.4A Banking and Monetary Statistics (1941-1970).

[b] This is the fixed ceiling rate on time accounts which mature in 30-89 days. See Table 8A of the Annual Statistical Digest (1970-1979). Ceiling rates for 1966.08-1973.06 are for 30 days to 1 year.

[c] This is the fixed ceiling rate for small denomination time deposits which mature in 6 months to 1 year. See Table 12.4A Banking and Monetary Statistics (1941-1970).

[d] Between 1965.12-1966.07 this is the fixed ceiling rate for small denomination time deposits which mature in 6 months to 1 year. Between 1966.08-1966.09 this is the fixed ceiling rate on single maturity time deposits of less than $100,000, which mature in 30 days to 1 year. See Table 12.4A Banking and Monetary Statistics (1941-1970).

[e] This is the fixed ceiling rate on time deposits of less than $100,000 which mature in 30 days to 1 year. See Table 8A of the Annual Statistical Digest (1970-1979).

[f] This is the fixed ceiling rate on time accounts which mature in 90 days to 1 year. See Table 8A of the Annual Statistical Digest (1970-1979).

[g] This is the fixed ceiling rate on other time deposits payable in 90 days to 6 months, from Table 12.4A Banking and Monetary Statistics (1941-1970).

constructed the variable ceiling rates which applied to various maturity small denomination time deposits based on information contained in the Annual Statistical Digest (1970-1979, 1980, 1981, 1982).[19] In Table 10, we list the variable ceiling rates and the market interest rates to which they were indexed.

Table 10 Variable Ceiling Rates

Variable Ceiling Rate	Market Rate	Period Introduced
Money Market Time Deposits at Commercial Banks	Discount Auction Average Rate on 6 Month Treasury Bills	1978.06
Money Market Time Deposits at Thrift Institutions	Discount Auction Average Rate on 6 Month Treasury Bills	1978.06
12 Month All Savers Certificates	Discount Auction Average Rate on 1 Year Treasury Bills	1981.10
7-31 Day Small Denomination Time Deposits at Commercial Banks	Discount Auction Average Rate on 3 Month Treasury Bills	1982.09
7-31 Day Small Denomination Time Deposits at Thrift Institutions	Discount Auction Average Rate on 3 Month Treasury Bills	1982.09
91 Day Small Denomination Time Deposits at Commercial Banks	Discount Auction Average Rate on 3 Month Treasury Bills	1982.05
91 Day Small Denomination Time Deposits at Thrift Institutions	Discount Auction Average Rate on 3 Month Treasury Bills	1982.05

The Market Interest Rate on Savings Bonds

Investment yields to maturity for series E savings bonds are available for 1960.1-1982.10. Starting in 1982.11, the Treasury Department issued bonds which paid a variable

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[18] In 1982.5, interest rate ceilings were removed on small denomination time deposits with maturities of three and one half years or longer. In 1983.10, all ceiling rates were removed from denomination small time deposits

[19] Specifically, the notes to Table 8A and 8B of the Annual Statistical Digest (1970-1979), and to Table 8 of Annual Statistical Digest (1980, 1981, 1982), detail the regulations which linked the variable ceiling rates to various auction average treasury security rates.

market interest rate. This market rate is constructed using the following procedure. The monthly five year Treasury securities yield is averaged over six months, with six month blocks beginning either on May 1 or November 1. The market based savings bond rate for the next six months is equal to 85% of the average.[20]

Own Rate Conversion

The application of aggregation theory and index number methodology to monetary data requires that all component own rates are reported on the same basis. This is generally not true in published data for two reasons: first, different sources have different reporting conventions, and second, own rates are reported for different maturities. The choice of common basis is arbitrary, therefore we could select any base without changing the aggregation results. We have chosen to convert all rates to an annualized monthly yield on a bond interest basis for consistency with past research.[21] In this subsection, we describe general procedures for adjusting own rates to a common basis.

The simplest own rate adjustment is to convert an annualized one month holding period yield quoted on a (360 day) bank interest basis to an annualized one month holding period yield quoted on a (365 day) bond interest basis. In this case the correct procedure is to simply multiply the unadjusted own rate by 365/360 to get the adjusted own rate.

The second type of adjustment is to convert an annual effective yield on a bond interest basis to an annualized one month holding period yield on a bond interest basis. The procedure we use is to convert the annual effective yield (in percentage terms) back to a daily rate,

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[20] This methodology was supplied to us by the Savings Bond Operations Office of the Department of the Treasury.

[21] Earlier research includes Barnett (1980), Barnett and Spindt (1982), Farr and Johnson (1985) and Thorton and Yue (1992).

compound that daily rate to a monthly rate, and then annualize it assuming a 30 day month. This produces an annualized one month holding period yield on a bond interest basis.

The third type of adjustment is to convert an annual effective yield on a bank interest basis to an annualized one month holding period yield on a bond interest basis. The procedure we use is similar to the previous one. Convert the annual effective yield on a bank interest basis (in percentage terms) back to a daily rate, compound that daily rate to a monthly rate, and then annualize to a bond interest basis assuming a 30 day month. This produces an annualized one month holding period yield on a bond interest basis.

The fourth type of adjustment is to convert a bank discount basis rate to an annualized one month holding period yield for a monetary asset with a maturity of n months. This conversion is discussed in Farr and Johnson (1985). The conversion is to assume that each month has 30 days and apply the following formula:

$$r^{adj} = \frac{365(r/100)}{360 - 30n(r/100)} \cdot 100,$$

where r is the own rate as an n month discount bank basis rate, and r^{adj} is the adjusted rate.[22]

In Table 11, we summarize the adjustment of the own rate data, by type of adjustment. In each case, r is the unadjusted own rate of the asset and r^{adj} is the adjusted own rate.

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[22] This conversion is only valid for rates with maturity of less than 6 months.

Table 11 Summary of Own Rate Adjustment

Adjustment Formula	Purpose of Adjustment	Own Rates Which Require The Adjustment
$r^{adj} = r \cdot (\frac{365}{360})$	Converts an annualized one month holding period yield on a bank interest basis to an annualized one month holding period yield on a bond interest basis	1 Month Eurodollar Rate 3 Month Eurodollar Rate 6 Month Eurodollar Rate 1 Month Cd Rate 3 Month Cd Rate 6 Month Cd Rate
$r^{adj} = ((1 + \frac{r/100}{365})^{30} - 1) \cdot (\frac{365}{30}) \cdot 100$	Converts an annual effective yield on a bond interest basis to an annualized one month holding period yield on a bond interest basis	Rate On NOW Accounts at Thrift Institutions Rate On NOW Accounts at Commercial Banks Rate On Super NOW Accounts at Thrift Institutions Rate On Super NOW Accounts at Commercial Banks 7 To 91 Day Small Time Rate at Commercial Banks 92 To 182 Day Small Time Rate at Commercial Banks 183 Day To 1 Year Small Time Rate at Commercial Banks 1 To 2.5 Year Small Time Rate at Commercial Banks 2.5 Year And Over Small Time Rate at Commercial Banks 7 To 91 Day Small Time Deposit Rate at Thrift Institutions 92 To 182 Day Small Time Deposit Rate at Thrift Institutions 183 Day To 1 Year Small Time Rate at Thrift Institutions 1 To 2.5 Year Small Time Rate at Thrift Institutions 2.5 Year And Over Small Time Rate at Thrift Institutions Rate On MMDAs at Commercial Banks Rate On MMDAs at Thrift Institutions Rate On Other Savings at Commercial Banks Rate On Other Savings at Thrift Institutions Rate On Savings Deposits at Commercial Banks Rate On Savings Deposits at Thrift Institutions

Table 11 Continued

Adjustment Formula	Purpose of Adjustment	Own Rates Which Require The Adjustment
$r^{adj} = ((1 + \frac{r/100}{360})^{30} - 1) \cdot (\frac{365}{30}) \cdot 100$	Converts an annual effective yield on a bank interest basis to an annualized one month holding period yield on a bond interest basis	Overnight Repurchase Agreement Rate Overnight Eurodollar Rate Overnight Federal Funds Rate
$r^{adj} = \frac{365(r/100)}{360 - 30n(r/100)} \cdot 100$	Converts an n month bank discount basis rate to an annualized one month holding period yield on a bond interest basis	1 Month (Secondary Market) Treasury Bill Rate 3 Month (Secondary Market) Treasury Bill Rate 6 Month (Secondary Market) Treasury Bill Rate 1 Month Commercial Paper Rate 3 Month Commercial Paper Rate 6 Month Commercial Paper Rate 3 Month Banker's Acceptance Rate 6 Month Banker's Acceptance Rate

Yield Curve Adjustment

In addition to the adjustments we have discussed, the liquidity premium associated with different maturites must be extracted from the own rates because own rates for monetary assets with different maturities are not directly comparable. Liquidity premia are extracted by *yield curve adjusting* the own rates. This is accomplished by estimating the liquidity premium based on the Treasury yield curve and subtracting this amount from the own rate. The following discussion of yield curve adjustment assumes that all own rates (including Treasury bill rates) have been converted to an annualized one month holding period yield on a bond interest basis.

Let r_n be an own rate for a monetary asset with a maturity of n months. Let r_n^T be the own rate on treasury securities which mature in n months, and r_1^T be the one month secondary market treasury bill rate.[23] The own rate, r_n, is yield curve adjusted by subtracting the estimated liquidity premium ($r_n^T - r_1^T$) from the own rate. The yield curve adjusted own rate, r_n^{YCA}, is given by:

$$r_n^{YCA} = r_n - (r_n^T - r_1^T) .$$

In Table 12, we detail the yield curve adjustment of the own rate data.

[23] The rate on Treasury securities which mature in n months, r_n^T, is defined for different n as follows. If n is one, three, or six months then r_n^T is the n month secondary market Treasury bill rate, adjusted from bank discount basis to an annualized one month holding period yield on a bond interest basis. If n is one, two, or three years, r_n^T is the corresponding constant maturity Treasury security. Other values of r_n^T can be interpolated by constructing a spline function. There are several rates that apply to assets with a range of maturities. In these cases, we have yield curve adjusted the rate using the rate for a Treasury security with a maturity which falls within the reported range. See Table 6 for precise details.

Table 12 Summary of Yield Curve Adjustment

All Rates are Adjusted to an Annualized One Month Yield on a Bond Interest Basis

Own Rate Series to be Yield Curve Adjusted (r_n)	Treasury Security Used to Adjust (r_n^T)
3 Month Eurodollar Rate 3 Month Commercial Paper Rate 3 Month Banker's Acceptance Rate 3 Month CD Rate 7 To 91 Day Small Time Deposit Rate At Thrifts 7 To 91 Day Small Time Deposit Rate At Commercial Banks Fixed Ceiling Rate on 3 Month Small Denomination Time Deposits Variable Ceiling Rate on 91 Day Small Denomination Time Deposits at Commercial Banks Variable Ceiling Rate on 91 Day Small Denomination Time Deposits at Thrift Institutions	3 Month Secondary Market Treasury Bill Rate
6 Month Eurodollar Rate 6 Month Commercial Paper Rate 6 Month Banker's Acceptance Rate 6 Month Secondary Market CD Rate 92 To 182 Day Small Time Deposit Rate at Thrift Institutions 92 To 182 Day Small Time Deposit Rate at Commercial Banks Variable Ceiling Rate on 6 Month Money Market Time Deposits at Commercial Banks Variable Ceiling Rate on 6 Month Money Market Time Deposits at Thrift Institutions	6 Month Secondary Market Treasury Bill Rate
183 Day To 1 Year Small Time Deposit Rate at Thrift Institutions 183 Day To 1 Year Small Time Deposit Rate at Commercial Banks Fixed Ceiling Rate on 1 Year Small Denomination Time Deposits Variable Ceiling Rate on 12 Month All Savers Certificates	1 Year Constant Maturity Treasury Security Rate
1 To 2.5 Year Small Time Rate at Thrift Institutions 1 To 2.5 Year Small Time Rate at Commercial Banks	2 Year Constant Maturity Treasury Security Rate
2.5 Year and Over Small Time Rate at Thrifts 2.5 Year and Over Small Time Rate at Commercial Banks	3 Year Constant Maturity Treasury Security Rate

USER COSTS OF MONETARY ASSETS IN DETAIL

We have described the own rate data in detail in the previous section. In this section, we describe the construction of user costs for the various monetary assets. We initially describe the procedure for constructing user costs of monetary assets which are simple sums of component assets, and then detail the user costs for each monetary asset in L.

Simple Sum Subindices and Leontief Dual User Costs

In Anderson, Jones, and Nesmith (1997), we discussed correct aggregation procedures under the assumption that each monetary asset stock m_{it}^{nom} is the optimal quantity of an elementary good at time *t*. Under this assumption, the correct real user cost associated with monetary asset *i* is given by,

$$\pi_{it}^{real} = \frac{R_t - r_{it}}{1 + R_t}.$$

Asset stock data are, however, often collected by the Federal Reserve Board for groups of assets.[24] Because the asset stocks within the group are simply summed to produce a group asset stock, we call assets of this type *simple sum subindices*. A simple sum subindex can be formally defined as a stock which is a simple sum of stocks of *k* distinct monetary assets. This combined stock data collection creates, literally, a sub-index. Sub-indexing is an application of aggregation theory at a more disaggregate level, but the underlying theory is the same as the theory we have described in previous sections. Simple sum sub-aggregation implies that each of the components of the sub-index are perfect substitutes. In general each of the k subcomponent assets, will have a separate own rate. Let $(\hat{r}_1, \hat{r}_2, \ldots, \hat{r}_k)$ be a vector of the own rates of the *k* subcomponents.[25] Microeconomic theory implies that consumers allocating expenditure over a group of perfect substitutes consume only the cheapest good in the group. Consequently, the user cost index dual to a simple sum index is Leontief (i.e. the minimum of the component user costs), because as we noted, construction of a simple sum subindex implicitly assumes that the components of the index are perfect substitutes.

The Leontief real user cost dual to the simple sum subindex, the stock of which at time t is denoted m_{it}^{nom}, at time t is defined by

$$\pi_{it}^{real} = \frac{R_t - max\{\hat{r}_{1t}, \hat{r}_{2t}, \ldots, \hat{r}_{kt}\}}{1 + R_t}.$$

Thus, it is necessary to construct the maximum own rate over the components of a simple sum subindex.

In most cases, the assumption that the subcomponent assets are perfect substitutes is not correct. Consequently, it is important to disaggregate the data as much as possible. Simple sum indexing severely distorts the information contained in the subcomponent data. The correct way to aggregate the subcomponents would be to form a superlative sub index. When particular asset stock data is available only in the form of a simple sum subindex, we produce the Leontief user cost dual to the simple sum subindex.

The User Costs by Component

In Table 13, we summarize the own rates used in the construction of the monthly user costs. The own rates are assumed to be adjusted to a common basis, yield curve adjusted, and

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[24] For example, various maturity small denomination time deposits are reported together. Beginning this year term and overnight repurchase agreements and term and overnight eurodollar accounts were combined.

proxied where appropriate. These operations were detailed in Tables 5, 11, and 12. The own rate series refer either to the own rate data in Table 4, or to data we constructed in the previous section. The footnotes to Table 13 contain additional information.

The construction of the real user costs necessitates not only these own rates but also the rate of return for a benchmark asset. The benchmark asset is a theoretical construct. In Anderson, Jones, and Nesmith (1997), it is described as an asset which does not provide any monetary services, is default risk free, and is used by the consumer only as an intertemporal store of wealth. A theoretical lower bound for the benchmark asset can be identified because the user costs of monetary assets must be positive. Thus, the benchmark asset must exceed the own rates for all monetary assets. One theoretical way of constructing the benchmark rate is to choose the maximum rate of return over a large class of assets (financial or non financial). The problem is that the rates of return cannot contain risk premia. This makes the use of unadjusted stock and bond returns inappropriate.

The traditional approach has been to identify the benchmark rate at each time period t as the "envelope" of the own rates of return on monetary assets and Moody's seasoned BAA bond rate, $r_{BAA,t}$,

$$R_t = \max_{i,BAA}\{ r_{it}\ (i = 1,2,\ldots,n),\ r_{BAA,t} \},$$

see Barnett and Spindt (1982), Farr and Johnson (1985), and Thornton and Yue (1992). We make a minor modification of this rate which allows us to define the Törnqvist-Theil asset stock growth rate variance, Törnqvist-Theil user cost growth rate variance, Törnqvist-Theil

[25] We note that all the subcomponent own rates must be reported on a common basis. The conversion of own rates is detailed a previous section.

expenditure share growth rate variance, and the Törnqvist-Theil asset stock / user cost growth rate covariance. We define the benchmark rate as

$$R_t^* = \max_{i,BAA}\{ r_{it} \ (i = 1,2,\ldots,n) \, , \, r_{BAA,t} \} + c \, ,$$

where c is a small constant. The actual value of the constant is set to less than a basis point, and therefore is smaller than the rounding error in the data. The indices are robust experimentally to much larger range of values for the constant.

Table 13 Own Rates Used to Construct the Monthly User Costs of Monetary Assets

Rates are Converted to a Common Basis, Yield Curve Adjusted, and Proxied as Summarized in Tables 5, 11, and 12

Asset Stock	Sample Period	Own Rates
		M1A Assets
Currency	1960.01-present	zero
Traveler's Checks	1960.01-present	zero
Demand Deposits	1960.01-present	Startz (1979) Rate[a]
		Non M1A Assets in M1
Other Checkable Deposits at Commercial Banks Net of Super NOW Accounts	1974.01-1985.12	Fixed Ceiling Rate on NOW Accounts at Commercial Banks
Other Checkable Deposits at Thrift Institutions Net of Super NOW Accounts	1960.01-1973.12 1974.01-1985.12	Startz (1979) Rate Fixed Ceiling Rate on NOW Accounts at Thrift Institutions
Super NOW Accounts at Commercial Banks	1982.12-1985.12	Rate on Super NOW Accounts at Commercial Banks
Super NOW Accounts at Thrift Institutions	1982.12-1985.12	Rate on Super NOW Accounts at Thrift Institutions
Other Checkable Deposits at Commercial Banks Including Super NOW Accounts	1986.01-present	Rate on NOW accounts at Commercial Banks
Other Checkable Deposits at Thrift Institutions Including Super NOW Accounts	1986.01-present	Rate on NOW Accounts at Thrift Institutions
		Non M1 Assets in MZM
Retail Money Funds	1973.02-present	Rate on Money Market Mutual Funds
Money Market Deposit Accounts (MMDAs) at Commercial Banks	1982.12-1991.08	Rate on MMDAs at Commercial Banks

[a] We remind the reader that the Startz rate is equal to (.58)(1-Maximum Required Reserve Ratio for Demand Deposits)(5 Year Treasury Constant Maturities Rate). We choose the maximum value of .58 rather than a value in the range .34-.58 because the parameter varies based on the size of the banks issuing the demand deposit. Consistent with our arguements on taking maximum own rates that apply to componenets of a simple sum subindex we choose the largest own rate consistent with Startz's findings. We make the assumption that the demand deposits in other checkable deposits at thrift institutions earned an implicit rate of return equal to the implicit rate of return on demand deposits at commercial banks.

Table 13 Continued

Asset Stock	Sample Period	Own Rates
Money Market Deposit Accounts (MMDAs) at Thrift Institutions	1982.12-1991.08	Rate on MMDAs at Thrift Institutions
Savings Deposits Net of MMDAs at Commercial Banks	1960.01-1986.03	Fixed Ceiling Rate on Savings deposits at Commercial Banks
	1986.04-1991.08	Rate on Other Savings at Commercial Banks
Savings Deposits Net of MMDAs at Thrift Institutions	1960.01-1969.12	Fixed Ceiling Rate on Savings deposits at Commercial Banks[c]
	1970.01-1986.03	Fixed Ceiling Rate on Savings deposits at Thrift Institutions
	1986.04-1991.08	Rate on Other Savings at Thrift Institutions
Savings Deposits Including MMDAs at Commercial Banks	1991.09-present	Rate on Savings Deposits and MMDAs at Commercial Banks
Savings Deposits Including MMDAs at Thrift Institutions	1991.09-present	Rate on Savings Deposits and MMDAs at Thrift Institutions
Non MZM Assets in M2		
Small denomination Time Deposits at Commercial Banks	1960.01-1966.07	Maximum of the Fixed Ceiling Rate on 3 month and 1 Year Small Denomination Time Deposits
	1966.08-1973.06	Ceiling Rate on 1 Year Small Denomination Time Deposit Rates
	1973.07-1978.05	Maximum of the Fixed Ceiling Rate on 3 month and 1 Year Small Denomination Time Deposits
	1978.06-1983.09	Maximum of the Variable Ceiling Rates on Money Market Time Deposits at Commercial Banks, 12 Month All Savers Certificates, 7-31 Day and 91 day Small Denomination Time Deposits at Commercial Banks
	1983.10-present	Maximum Rate of Return on 7 to 91 day, 92 to 182 day, 183 day to 1 year, 1 to 2.5 year, and 2.5 year and over Small Denomination Time Deposits at Comm. Banks

[c] Savings deposits at thrift institutions were not regulated during the entire decade. We made the decision to use the ceiling rate on savings deposits at commercial banks because we lack adequate data, to make a more reasonable assumption.

Table 13 Continued

Asset Stock	Sample Period	Own Rates
Small denomination Time Deposits at Thrift Institutions	1960.01-1978.05	Own Rate on Small Denomination Time Deposits at Commercial Banks Plus 25 Basis Points[d]
	1978.06-1983.09	Maximum of the Variable Ceiling Rates on Money Market Time Deposits at Thrift Institutions, 12 Month All Savers Certificates, 7-31 Day and 91 day Small Denomination Time Deposits at Thrift Institutions
	1983.10-present	Maximum Rate of Return on 7 to 91 day, 92 to 182 day, 183 day to 1 year, 1 to 2.5 year, and 2.5 year and over Small Denomination Time Deposits at Thrift Institutions
Non M2 Assets in M3		
Large denomination Time deposits	1960.01-1964.05	6 Month Ceiling Rate on Large Time Deposits
	1964.06-1965.11	Maximum of the Rate on 3, and 6 Month Secondary Market Certificate of Deposits
	1966.01-present	Maximum of the Rate on 1, 3, and 6 Month Secondary Market Certificate of Deposits
Total Repurchase Agreements	1969.10-present	Overnight Repurchase Agreement Rate
Total Eurodollars	1960.01-1963.04	3 Month Term Eurodollar Rate
	1963.05-1970.12	Maximum of the 3 and 6 Month Term Eurodollar Rates
	1971.01-present	Maximum of the 1,3, and 6 Month Term Eurodollar Rates and the Overnight Eurodollar Rate
Institutional Money Funds	1974.01-present	Rate on Money Market Mutual Funds
Non M3 Assets in L		
Short Term Treasury Securities	1960.01-present	1 Month Secondary Market Treasury Bill Rate
Banker's Acceptances	1960.01-1975.12	3 Month Banker's Acceptance Rate
	1976.01-present	Maximum of the 3 and 6 Month Banker's Acceptance Rates
Commercial Paper	1960.01-1971.03	6 Month Commercial Paper Rate
	1971.04-present	Maximum of the 1, 3, and 6 Month Commercial Paper Rates
Savings Bonds	1960.01-1982.10	Investment Yields to Maturity for Series E Savings Bonds
	1982.11-present	Market Interest Rate for savings Bonds

[d] Following Farr and Johnson (1985)

INDEX NUMBER THEORY PROBLEMS: NEW ASSETS, CHANGES IN DEFINITIONS AND OTHER ISSUES

Several additional problems are encountered when constructing monetary services indices. The first is the introduction of new monetary assets. The second is changes in the definitions of asset stock data. The third relates to the calculation of the indices at different frequencies. The fourth relates to seasonal adjustment. These issues are addressed in the following subsections.

Introduction of New Monetary Assets

During the time span over which we have constructed monetary services indices, there has been a great deal of financial innovation. Consequently, new monetary assets have been created at various periods, and the indices must be modified to include them.

It can be shown that the nominal Törnqvist-Theil monetary services index is not well defined when new assets enter the aggregate.[26] The Fisher ideal real user cost index, P_t^F, defined by

$$P_t^F = P_{t-1}^F \sqrt{\frac{\sum_{j=1}^{n} \pi_{jt}^{real} m_{jt}^{nom}}{\sum_{j=1}^{n} \pi_{j,t-1}^{real} m_{jt}^{nom}} \cdot \frac{\sum_{j=1}^{n} \pi_{jt}^{real} m_{j,t-1}^{nom}}{\sum_{j=1}^{n} \pi_{j,t-1}^{real} m_{j,t-1}^{nom}}},$$

is well defined over the same period and thus we could switch to the Fisher ideal index in periods when new monetary assets are introduced. To implement this approach, we need to define the user cost of the new asset in the period before it is introduced. Theoretically, the correct solution

[26] The CE and simple sum indices are well defined and do not require any modifications when new assets are introduced (although there may be jumps in the indices). The Divisia second moments are left undefined in these periods, and the Törnqvist-Theil real user cost index is corrected using the procedure discussed in this section.

is to define a user cost sufficiently high that a zero quantity of the asset would have been demanded in the period, if the asset had in fact existed. In practice, doing this correctly requires econometric estimation of the true aggregator function, a difficult task; see Diewert (1980). Farr and Johnson (1985) advocate the Fisher Ideal index because it is well defined even when new assets are introduced, but the properties of the Fisher ideal index are not known when first-degree homogeneity of the aggregator function fails to hold. The Törnqvist-Theil index's superlative properties are valid even when linear homogeneity does not hold, which is the reason we advocate using the following method introduced by Diewert (1980), based on the Törnqvist-Theil index.

In the period when a new monetary asset is introduced, Diewert (1980) suggests calculating the Fisher ideal real user cost index over all monetary assets except the new one, which we will call P_t^{**}. If monetary asset i is introduced in period t, P_t^{**} will be defined by

$$P_t^{**} = P_{t-1}^{**}\sqrt{\frac{\sum_{j\neq i}\pi_{jt}^{real}m_{jt}^{nom}}{\sum_{j\neq i}\pi_{j,t-1}^{real}m_{jt}^{nom}}\cdot\frac{\sum_{j\neq i}\pi_{jt}^{real}m_{j,t-1}^{nom}}{\sum_{j\neq i}\pi_{j,t-1}^{real}m_{j,t-1}^{nom}}}\,.$$

Diewert (1980) advocates this procedure because it will, in general, have lower bias than the other available alternatives, in the absence of strong information about the reservation user cost, and Diewert and Smith (1994) make use of the procedure.[27] This procedure will be exactly correct in a special case. If the actual user cost of asset i in period t divided by the reservation user cost is equal to

[27] Diewert actually suggests this procedure in the general case, we state it here in the case of monetary aggregation.

$$\frac{\sum_{j \neq i} \pi_{jt}^{real} m_{jt}^{nom}}{\sum_{j \neq i} \pi_{j,t-1}^{real} m_{jt}^{nom}},$$

then the bias from using P_t^{**} will be zero.

We form the real user cost index using Diewert's recommended approach during periods in which new monetary assets enter the indices. The dual monetary services index is then defined implicitly by factor reversal.

In Table 14, we list the periods in which new monetary assets are introduced.

Table 14 Introduction of New Assets

New Asset	Period When New Asset is Introduced
Total Repurchase Agreements	1969.10
Retail Money Funds	1973.02
Other Checkable Deposits at Commercial Banks	1974.01
Institutional Money Funds	1974.01
Money Market Deposit Accounts at Commercial Banks	1982.12
Money Market Deposit Accounts at Thrift Institutions	1982.12
Super NOW Accounts at Commercial Banks	1982.12
Super NOW Accounts at Thrift Institutions	1982.12

Changes in the Definitions of Asset Stock Data

In the preceding section, we have discussed the introduction of new monetary assets. A related problem is that the Federal Reserve changes its definition and reporting of the component monetary asset stocks. This happens twice in our series: (1) after 1985.12, Super NOW accounts are included in Other Checkable Deposits, and (2) after 1991.08, Money Market Deposit Accounts and Savings deposits are reported only a combined basis, for both thrift institutions and commercial banks. In both these cases, monetary assets that had been reported separately were combined into simple sum subindices, and the separate component data are no longer available. These changes represent a redefinition of the asset stocks (and consequently the monetary services indices), but do not represent a meaningful change in the structure of the economy, in other words they are accounting changes and are not necessarily economically relevant. The official simple sum indices are invariant to accounting changes in the definition of the asset stock data because the simple sum index is itself an accounting relation. Törnqvist-Theil monetary services indices are not invariant to these changes because the change in reporting, from a block of assets to a single simple sum subindex, represents a loss of information. In this section, we describe our approach to this problem.[28]

From 1983.01 through 1985.12 the Törnqvist-Theil monetary services index is computed with super NOW accounts included as a separate asset; beginning in 1986.01, super NOW accounts are combined with Other Checkable Deposits. To cope with this change, we define a new Törnqvist-Theil monetary services index that begins in 1985.12 in which super NOW accounts and other checkable deposits are a single category. Both of these indices are defined in the period 1985.12, but the initial value (in 1985.12) of the second index is arbitrary. This allows us to scale the second index to equal the first in 1985.12, which splices the two indices to produce a single Törnqvist-Theil monetary services index over the entire period. We perform an analogous operation in 1991.08 when Money Market Deposit Accounts and Savings deposits are combined.[29]

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[28] The CE and simple sum indices are well defined and do not require any modifications when asset stocks are redefined. The real user cost index dual to the Törnqvist-Theil monetary services index is calculated by factor reversal. The Törnqvist-Theil real user cost index and the Törnqvist-Theil expenditure share index are calculated using a similar splicing procedure as the one described in this section.

[29] We note that the splicing procedure requires asset stock and user cost data for Other Checkable Deposits Including Super NOW Accounts at Commercial Banks and Other Checkable Deposits Including Super NOW Accounts at Thrift institutions in 1985:12, and both asset stock and user cost data for Savings Deposits Including MMDAs at Commercial Banks and Savings Deposits Including MMDAs at Thrift Institutions in 1991.08. In 1985.12, the asset stock for the combined checkable deposit categories is the sum of the asset stocks of the subcomponents, and the user cost for the combined checkable deposit

Accounting changes (not based on economic reasoning) which produce simple sum sub-indices represent a loss of information. Our solution preserves the information over the periods when disaggregation is possible without imputing economic relevancy to the change when it occurs. Our solution to this problem draws on the literature of index number splicing. For a general discussion about theoretically correct procedures for splicing index numbers, see Hill and Fox (1995).

Indices at Different Frequencies

Most disaggregated data in the MSI database are reported monthly. In some applications monetary aggregates must be available at quarterly or annual frequency. In this section, we discuss a method due to Diewert (1980) for constructing aggregates at quarterly and annual frequencies.

Consider the problem of constructing annual indices from monthly indices. The solution to this problem is to treat asset in different months as different assets, aggregating over them as separate assets. For example, demand deposits in December – when Christmas shopping is near its peak – are treated as a different asset from demand deposits in January. Formally, let m_{it}^{r} be the nominal stock of monetary asset i in month r of year t. Similarly let π_{it}^{r} be the real user cost associated with m_{it}^{r} defined by

$$\pi_{it}^{r} = \frac{R_t^r - r_{it}^r}{1 + R_t^r}$$

categories is constructed from the weighted average of the subcomponent own rates. In 1991.08, the combined saving and MMDA categories is from the Board of Governors.

where R_t^r is the rate of return on the benchmark asset in month r of year t, and r_{it}^r is the rate of return on the nominal stock of monetary asset i in the month r of year t. Then the log change of the annual Törnqvist-Theil nominal monetary services index, M_t^{annual} is defined by

$$\Delta log(M_t^{annual}) = \sum_{i=1}^{n} \sum_{r=1}^{12} \bar{s}_{it}{}^r \Delta log(m_{it}{}^r)$$

where

$$\bar{s}_{it}{}^r = \tfrac{1}{2}(s_{it}{}^r + s_{i,t-1}{}^r)$$

and

$$s_{it}{}^r = \frac{\pi_{it}{}^r m_{it}{}^r}{\sum_{j=1}^{n} \sum_{r=1}^{12} \pi_{jt}{}^r m_{jt}{}^r}.$$

In the MSI databases, this method is used to produce both annual and quarterly indices. Dual user cost indices are obtained by factor reversal.[30]

Seasonal Adjustment

The issue of seasonal adjustment is a difficult one. Index number theoretic methods for dealing with seasonality, which are related to the issues discussed in the section of this paper dealing with indices at different frequencies, can be found in Diewert (1980). Our approach is more traditional. We produce the indices in the database using both seasonally adjusted and non-seasonally adjusted asset stock data, except for the non-M3 components of L, which are not seasonally adjusted in either set of indices.

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[30] At quarterly and annual frequencies the splicing procedure described in the preceding subsection needs to be modified in a straightforward way.

CONCLUSION

The St. Louis MSI database is an important resource for economists and policymakers studying the role of money in the economy. The purchase of monetary services is an important aspect of the economic behavior of households and firms, and the MSI provide new up-to-date measures of the quantities of such monetary services "purchased" by economic agents via the opportunity costs of the monetary assets they choose to hold. The database also contains dual measures of the opportunity cost of monetary services, and related stock and total expenditure variables. The indices in the MSI database are consistent with microeconomic aggregation theory, and are constructed in the same way as many commonly used macroeconomic indices (such as GDP). Therefore, the monetary indices in the MSI database can be used in well specified microeconomic based approaches to macroeconomic modeling. Use non-monetary macroeconomic (quantity and price) indices will generally be consistent with the use of the monetary quantity and user cost (price) indices in this database, for example in the construction of household demand for monetary services or factor demand by firms for monetary services. In general, the use of simple sum measures of money for the purpose of demand estimation is not consistent either with the underlying microeconomics theory or with the construction of most other reputable macroeconomic indices. The MSI database also contains disaggregate asset stock and user cost data which will allow researchers to study the demand for the disaggregated monetary assets in a way which is consistent with microeconomic models of decision making.

The database is also comprehensive enough to allow researchers to vary key assumptions such as the level of aggregation, the construction of particular own rate series, seasonal adjustment techniques, etc. These same data provide numerous opportunities for new applied monetary research. Although monetary services indices have been produced before by Barnett and Spindt (1982), Farr and Johnson (1985), and Thornton and Yue (1992), none of these studies furnished as broad a set of indices, the underlying data and the computer programs necessary to build the indices.

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