

## Editor's Introduction

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Monetary aggregates have played a prominent role in policy research at the Federal Reserve Bank of St. Louis for more than 25 years. The Bank's 18th annual Economic Policy Conference in October 1993 brought together a variety of evidence on the interaction between the use of monetary aggregates in policymaking and measurement of the money stock.

The first session of the conference addressed issues in the construction of monetary aggregates. Milton Friedman and Anna Schwartz have noted that measurement of the stock of money in the United States is an activity almost as old as the republic itself. Their well-known histories of these data, however, largely precede both the first modern monetary aggregates published by the Federal Reserve in 1960 and the aggregates used today in macroeconomic research. In the first paper presented at the conference, Richard Anderson and Kenneth Kavajecz review the history and construction of the Federal Reserve's monetary aggregates.

Following a broad introductory discussion of definitional and statistical issues, Anderson and Kavajecz trace the history of the Federal Reserve's monetary aggregates since 1943. They describe in detail the sources of data used in building the current aggregates, cautioning the reader that a wide variety of data are received and incorporated into the aggregates throughout the year. Because various Federal Reserve publications are released at different times, observations on a monetary aggregate in one publication may differ significantly from observations in another. Moreover, data in different issues of the same publication more than a year apart may not be comparable since the monetary aggregates are benchmarked each year to incorporate additional incoming data and new seasonal adjustment factors. The authors find that these annual benchmarks often significantly change published growth rates for the monetary aggregates, although the size of the revisions is small except

for the most recent years. The authors conclude with a summary of the Federal Reserve's use of monetary aggregates as monetary targets.

The article is followed by a unique timeline compiled by Kenneth Kavajecz that traces the history of the Federal Reserve's monetary aggregates from 1960-93. The date of each change in definition and benchmark revision is included, as well as descriptions of many special events that affected the monetary aggregates. Of general interest to all readers, the chronology will be invaluable to researchers working with high-frequency data on the monetary aggregates.

In his commentary, Charles Calomiris proposes a number of reasons why empirical economists should be concerned about the construction of the monetary aggregates data that they use in their research. Since tests of many hypotheses in modern macroeconomics require long time series of data, researchers may be at risk by ignoring issues such as changes in sampling and seasonal adjustment procedures used by the data constructors. Further, the construction of long time series is complicated by the Fed's frequent retrospective revisions and redefinitions of the monetary aggregates. Calomiris also notes that the redefinitions discussed by Anderson and Kavajecz call into question the usefulness of the monetary aggregates for testing many propositions in macroeconomics. If the redefinitions are motivated by a desire to make the new aggregate better track economic activity, then the redefined aggregates may not be suitable for tests of the structural stability of macroeconomic relationships, including money demand.

A number of economists have argued over the last 15 years that simple-sum monetary aggregates of the type published by the Federal Reserve Board are not defensible in terms of either economic aggregation or statistical index number theory. These researchers have suggested a number of alternative measures of the money stock including the Divisia monetary aggregate

proposed by Barnett and the currency-equivalent aggregate suggested by Rotemberg. In the conference's second paper on the policy implications of differing measures of the money stock, K. Alec Chrystal and Ronald MacDonald compare the indicator properties of simple-sum aggregates to those of alternative measures of money in seven industrialized countries.

The authors' first set of tests is based on a variant of the classic St. Louis reduced-form equation for nominal output. Perhaps as might be expected, the results show little difference between the indicator properties of narrow simple-sum and Divisia aggregates. For broader aggregates, however, the Divisia aggregates are generally found to be preferable to simple-sum aggregates. Next, the authors conduct a series of sophisticated multivariate causality tests based on estimated error-correction models. These tests also suggest that Divisia aggregates are preferred to simple-sum aggregates, although the results are not so strong as to find that a Divisia aggregate has significant indicator value when a simple-sum aggregate does not. In a test on U.S. data since 1980—a period of extensive financial innovation—the authors find particularly strong support for the superior indicator properties of a Divisia M2 index relative to the simple-sum M2 aggregate.

In his commentary, Charles Nelson notes that the authors' specification of the St. Louis equation for the U.S. is not comparable to that for their other countries, with the former better seen as a structural demand equation and the latter as reduced-form equations. For the U.S., although differences between results based on alternative various M1 and M2 aggregates may be reasonable, he finds puzzling the sharp differences among results for M1 and Divisia M1 and M1A when one might have expected the three aggregates to closely resemble each other.

Nelson also questions the authors' causality inferences drawn from their estimated error-correction models. Emphasizing that monetary aggregates enter the error-correction models through both the first differences of their growth rates and the error-correction terms (which are specified in growth rates rather than levels), he suggests that Chrystal and MacDonald's emphasis solely on the significance of the coefficients on the first differences of growth rates may be misplaced. Strong significance of the error-correction terms in some equations suggests

more of a role for monetary aggregates than the authors perhaps recognize.

The papers presented in the second session addressed a pair of econometric issues in measurement of monetary aggregates. Financial assets, like other goods, are demanded by households because they yield a flow of services. This simple insight suggests the potential value of analyzing the demand for money in the context of a multivariate expenditure system, rather than as a single isolated demand equation. Despite its intuitive appeal, the expenditure system approach has had limited acceptance due to a number of shortcomings. Most prominent perhaps has been uncertainty regarding the correct functional form. This uncertainty has led to widespread use of flexible functional forms able to furnish (at least) a second-order approximation to the true unknown function at (at least) one point.

The Fourier flexible functional form proposed by Gallant solves the approximation problem by providing an arbitrarily accurate global approximation to any unknown function and its partial derivatives. Expenditure systems based on this functional form typically have been static, however, limiting their usefulness with economic time series data. Douglas Fisher and Adrian Fleissig propose and compare two dynamic extensions of the Fourier functional form. Their estimates of dynamic expenditure systems that include monetary assets suggest that the dynamic models are more consistent with the data than the Fourier static model. In particular, the dynamic models seem to provide much sharper estimates of the elasticities of substitution between the various types of monetary assets held by households.

No econometric model can be all things, but James Swofford concludes in his commentary that Fisher and Fleissig have done a commendable job of achieving the goals they set forth for their model. Their dynamic extension of the Fourier functional form is an important contribution, likely of value to many future researchers. He notes, however, that although their elasticity estimates are plausible, many readers may find them difficult to interpret. The reader who is primarily interested in understanding household money demand may miss entirely the importance of estimating expenditure systems if authors, including Fisher and Fleissig, fail to provide a thorough discussion of their findings. Swofford also concludes that Fisher and Fleissig's

model fares laudably well against the very demanding criteria proposed by Carl Christ at last year's St. Louis economic policy conference.

The next paper addresses the relatively new topic of supply-side monetary aggregation. Measured money stocks in most economies are primarily composed of inside money or, in other words, of the liabilities of profit-maximizing firms. The supply-side aggregation conditions applicable to the monetary services produced by these liabilities differ from those more commonly studied in the demand-side monetary aggregation literature. Recognition of the risk and uncertainty facing these intermediaries further complicates aggregation, since existing economic aggregation conditions and index number theory (such as that for Divisia monetary aggregates) have usually considered only cases of perfect certainty. William Barnett and Ge Zhou introduce to the literature a stochastic model of monetary services production by banks under uncertainty. In the model, banks are treated as neoclassical competitive firms that maximize the present value of expected utility. The banks contract for deposits and real factor inputs (labor, for example) at the beginning of each period. During the period, three variables—the economy's average price level, reserve requirement ratios for each deposit type, and the ex post realized rate of return on loans—are determined by random processes not controllable by the firm. The empirical results support the hypothesis that the banks' deposit liabilities are weakly separable from purchased real factor inputs such as labor. A comparison of the Divisia, simple-sum, and currency-equivalent monetary aggregates to the model's estimated exact monetary aggregate suggests that the ability of the Divisia index to track the exact aggregate is little diminished under uncertainty. This conclusion is invariant to whether the exact aggregate is constructed from model estimates based on alternative assumptions of risk neutrality and risk aversion.

In his commentary, William Brainard notes the increasing importance of studies of the supply of monetary assets. Unlike simpler times, when the money stock could be well measured by summing currency and demand deposits, today's relatively low costs of substituting among a wide variety of financial assets makes less certain both the measurement and control of monetary aggregates. Brainard notes, however, that the dynamic structure of the model may

not be as rich as the authors suggest. In particular, the period-by-period balance sheet constraint imposed by Barnett and Zhou as equation 2 prevents the model firm from carrying retained earnings (or losses) forward. Each period, the firm's available resources include only the deposits and real inputs contracted for at the beginning of that period plus a fixed amount of capital; in turn, all earnings must be paid out to the owners of the firm at the end of the period since the balance sheet constraint prevents any from being carried forward into the next. He suggests that the apparent dynamic structure of the profit function in their equation 3 arises because Hancock's profit function, equation 1 in Barnett and Zhou, differs from the cash flow that the firm will in fact receive in each period, conditional on its decisions and the stochastic nature of the economy. This reservation aside, the richness of Barnett and Zhou's paper is reflected in the numerous extensions proposed by Brainard for future researchers.

In a response to Brainard, Barnett and Zhou present additional results clarifying the dynamics of their model. The model requires some type of temporal separability restriction on either the discounted profit stream or the intertemporal utility function to avoid the intractable problem of estimating a system of simultaneous Euler equations. The formulation employed by Barnett in previous work, and preferred by Brainard, appears as but one of a number of alternative separability hypotheses. The relative plausibility of the hypotheses remains a subject for further empirical research.

Papers at the conference's final session once again turned to the implications of alternative measures of the money stock for the conduct of monetary policy. Monetary policymakers often rank price stability first among their goals. During the 1970s, central banks worldwide adopted growth targets for monetary aggregates that they hoped would guide them toward price stability. In many countries, however, initial optimism became disappointment as Goodhart's law—that the behavior of a monetary aggregate will change when the central bank targets its growth—seemed to prevail. Jerome Stein studies whether Goodhart's law has applied with equal force in the United States to all measures of the money stock. Working with the dynamic model he developed with Infante in the 1980s, Stein demonstrates that the short-run stability of the linkage between inflation and money growth is

apparent only when the model includes a variable representing the state of the economy, measured in his model by the difference between the current and long-run equilibrium unemployment rates. In that case, the growth of M2 arises as a good indicator of movements in both inflation and unemployment. Further, M2's indicator properties appear superior to those of statistical index number monetary aggregates, including Divisia M2, the currency-equivalent aggregate CE, and a Divisia CE aggregate. Regardless of its indicator value, a monetary aggregate must be controllable before it can be chosen as a policy target. Stein concludes that none of the broad monetary aggregates are sufficiently controllable to be used as targets. He finds, however, that adjusted bank reserves appear to be an acceptable target for control of the inflation rate.

Although monetary aggregates may be valuable indicators of the stance of monetary policy, they are not necessary for central banks to achieve price stability. Agreeing with Stein that the long-run inflation rate is largely determined by growth of the money stock, Frederic Mishkin notes that Federal Reserve policy has supported a relatively low, steady inflation rate during the last decade without strict adherence to any monetary target. He suggests that the highly dynamic nature of Stein's model might help explain the relatively poor showing of M2 per se as an indicator for individual variables such as inflation and real output while being a valuable indicator for nominal GDP. Since real output growth accelerates more quickly following a monetary shock than inflation and later tends to slow while inflation accelerates, cyclical movements in M2 may be more closely correlated with both short- and long-run movements in nominal GDP than with either inflation or real output separately. At the same time, Mishkin finds troubling the poor fit of the model to quarterly data which may indicate that Stein's empirical surrogate model is not capturing well the dynamic interactions prominent in the SM theoretical model. Also puzzling are the very different conclusions reached by Stein and by Chrystal and MacDonald regarding the relative indicator properties of simple-sum and Divisia M2. Finally, Mishkin emphasizes that the omission of rational expectations from Stein's model prevents him from analyzing the importance of credibility in policymaking. Announced targets for monetary aggregates might help prevent sharp jumps in inflationary expectations by sig-

nalling the public that the central bank is serious about achieving its inflation targets. In this event, monetary aggregate targets might help the central bank stabilize the inflation rate even when measurement of the monetary aggregate is uncertain or monetary aggregates are not highly controllable.

The conference concluded with a panel discussion of the role of monetary aggregates in feedback rules for the conduct of monetary policy. Monetary aggregates have historically been constructed to guide monetary policy. The introduction of rational expectations into macroeconomic models emphasized that the feedback rules by which policymakers adjust growth of monetary aggregates are an important part of the structure of the economy.

In the panel discussion, Michael Boskin suggests that Federal Reserve actions under Alan Greenspan, and to some lesser extent under Paul Volcker, should be viewed as a rules-based policy. He sees the Fed as setting out a strategy whereby its actions in most periods are governed by pursuit of its goal of long-run price stability, rather than by a feedback rule based on a monetary aggregate. Temporary deviations from pursuit of the goal are permitted for exigencies that are well understood by the public. Further, in his view, the Federal Reserve will never find satisfactory any policy rule that includes only a small set of monetary aggregates or similar indicator variables.

Behavioral rules arise naturally as solutions in decision-theoretic models. Could a monetary policy rule based on monetary aggregates arise as the solution to a decision problem? The second panelist, Philip Dybvig, proposes a complete prototypical decision framework for the Fed, including an objective function, control variables, constraints and a well-defined information set. Although too much of the structure remains unknown to obtain explicit solutions, he concludes that future research on the value of monetary policy rules and the role of monetary aggregates might usefully be guided by such a framework.

Some researchers have argued that monetary aggregates have little value as either policy targets or indicators. If so, discussion of their measurement seems vacuous. The third panelist, Bennett McCallum, concludes the conference by suggesting that monetary aggregates are indeed irrelevant to the conduct of monetary policy. In

his framework, the central bank's main job is to keep nominal GDP growing smoothly at a noninflationary rate. Even when the penultimate goal is price stability rather than stable growth of nominal output, he argues that we know much better what growth rate for nominal GDP is likely to be consistent with long-run price stability than we do the appropriate long-run growth rates for M1 or M2. McCallum's research sug-

gests that directly targeting the growth of nominal GDP through control of the monetary base is preferable to targeting any monetary aggregate, no matter how measured.

Richard G. Anderson  
St. Louis, Missouri  
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