# The End of the Great Moderation: "We told you so."

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# The End of the Great Moderation: "We told you so."

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**ABSTRACT:** The current financial crisis followed the "great moderation," according to which the world's central banks had gotten so good at countercyclical policy that the business cycle no longer existed. As more and more economists and media people became convinced that the risk of recessions had moderated or ended, lenders and investors became willing to increase their leverage and risk-taking activities. Mortgage lenders, insurance companies, investment banking firms, and home buyers increasingly engaged in activities that would have been considered unreasonably risky, prior to the great moderation that was viewed as having lowered systemic risk. It is the position of this paper that the great moderation did not reflect improved monetary policy, and the perceptions that systemic risk had decreased and that the business cycle had ended were false. Contributing to those misperception was low quality data provided by central banks.

Since monetary assets began yielding interest, the simple sum monetary aggregates have had no foundations in economic theory and have sequentially produced one source of misunderstanding after another. The bad data produced by simple sum aggregation have contaminated research in monetary economics, have resulted in needless "paradoxes," have produced decades of misunderstandings in economic research and policy, and contributed to the widely held views about decreased systemic risk. While better data, based correctly on index number theory and aggregation theory, now exist, the usual official central bank data are not based on that better approach. While aggregation-theoretic monetary aggregates exist for internal use at the European Central Bank, the Bank of Japan, and many other central banks throughout the world, the only central banks that currently make aggregation-theoretic monetary aggregates available to the public are the Bank of England and the St. Louis Federal Reserve Bank. Dual to the aggregation-theoretic monetary aggregates are the aggregation-theoretic user cost and interest rate aggregates, which similarly are not in official use by central banks. No other area of economics has been so seriously damaged by data unrelated to valid index-number and aggregation theory.

Many commentators have been quick to blame insolvent financial firms for their "greed" and their presumed self-destructive, reckless risk taking. Perhaps some of those commentators should look more carefully at their own role in propagating the misperceptions of the great moderation that induced those firms to be willing to take such risks.

**KEY WORDS:** Measurement error, monetary aggregation, Divisia index, aggregation, monetary policy, index number theory, exchange rate risk, multilateral aggregation, open economy monetary economics.

**JEL CLASSIFICATION CODE:** E40, E52, E58, C43

# *1.* Introduction

### *1.1. The Great Moderation and the Current Crisis*

Over the past couple of decades, there has been an increasingly widely accepted view that there has been a "Great Moderation" in the economy's dynamics, reflecting dramatically improved monetary policy and resulting in the end of serious business cycles. Even Lucas (2003), who had become a major authority on the business cycle through his path-breaking publications in that area (see, e.g., Lucas (1987), had concluded that economists should redirect their efforts towards long term fiscal policy aimed at increasing economic growth. Since central banks had become so good at controlling the business cycle, he had concluded that there were few gains remaining from further improved countercyclical policy, and the welfare gains from such further moderations in the business cycle were small.

Then who is to blame for the recent crisis, which increasingly is being viewed as the worst since the Great Depression? The common view is that the firms and households that are in trouble are to blame. According to most of the popular press and many politicians, the Wall Street professionals and bankers are to blame for having taken excessive, self-destructive risk out of "greed." Homeowners similarly are viewed as having taken excessive risk. But who are the Wall Street professionals who decided to increase their leverage to 35:1? As is well known, they comprise an elite, including some of the country's most brilliant financial experts. Is it reasonable to assume that such people made foolish, self-destructive decisions out of "greed." If so, how should we define "greed" in economic theory, so that we can test the hypothesis? What about the mortgage lenders at the country's largest banks? Were their decisions dominated by greed and self-destructive, foolish behavior? Economic theory is not well designed to explore such hypotheses, and if the hypotheses imply irrational behavior, how would we reconcile a model of irrational behavior with the decisions of some of the country's most highly qualified experts in finance? Similarly how would one explain the fact that the Supervision and Regulation Division of the Federal Reserve Board's staff closed its eyes to the high risk loans being made by banks? Were they simply not doing their job, or perhaps did they too believe that systemic risk had declined, so that increased risk taking by banks was prudent?

It is our view that those financial firms and homeowners who have become insolvent and have been or may be "bailed out" by the government are victims of the crisis, rather than the cause. To find the cause of the crisis, it is necessary to look carefully at the data that produced the impression that the business cycle had been eliminated by improved monetary policy. To find the cause of the "Great Moderation," central bank policy is the wrong place to look. The federal funds rate has been the instrument of policy in the U.S. for over a half century, and the Taylor rule, rather than being an innovation in policy design, is widely viewed as fitting historic Federal Reserve behavior for a half century.[1] The Great Moderation was largely an illusion produced by events unrelated to monetary policy, such as the growth of U. S. productivity and the rise of China as a holder of American debt and supplier of low priced goods, permitting an expansionary monetary policy that otherwise would have been inflationary. This paper provides an overview of some of the data problems that produced the misperceptions of superior monetary policy and of the end to business cycles. This paper's emphasis is on graphical displays. For a more detailed overview of those data problems, including a survey of the relevant theory, see Barnett and Chauvet (2009), and for an earlier survey, see Barnett, Fisher, and Serletis (1992).

### *1.2. Overview*

Barnett (1980) derived the aggregation-theoretic approach to monetary aggregation and advocated the use of the Divisia or Fisher Ideal index with user cost prices in aggregating over monetary services. Since then, Divisia monetary aggregates have been produced for many countries.[2] But despite this vast amount of research, most central banks continue to supply the disreputable simple-sum monetary aggregates, which have no connection with aggregation and index number theory. The simple sum monetary aggregates have produced repeated inference errors, policy errors, and needless paradoxes leading up to the most recent misperceptions about the source of the Great Moderation. In this paper, we provide an overview of that history.

We conclude with a discussion of the most recent research in this area, which introduces state-space factor modeling into this literature. We also display the most recent puzzle regarding Federal Reserve data on nonborrowed reserves and show that the recent behavior of that data contradicts the definition of nonborrowed reserves: in short, it is an oxymoron. Far from resolving the earlier data problems, the Federal Reserve's most recent data may be the most puzzling that the Federal Reserve has ever published.

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[1] In fact the economists at the Federal Reserve Board who advocated the use of optimal control theory in policy making view the Taylor rule as a greatly simplified version of the far more sophisticated feedback rules that they had advocated in the early 1970s.

[2] For example, Divisia monetary aggregates have been produced for Britain (Batchelor (1989), Drake (1992), and Belongia and Chrystal (1991)), Japan (Ishida (1984)), the Netherlands (Fase (1985)), Canada (Cockerline and Murray (1981)), Australia (Hoa (1985)), and Switzerland (Yue and Fluri (1991)), among many others. More recently, Barnett (2007) has extended the theory to multilateral aggregation over different countries with potentially different currencies, and Barnett and Shu (2005) have extended to the case of risky contemporaneous interest rates, as is particularly relevant when exchange rate risk is involved. That research was particularly focused on the needs of the European Central Bank.

### *1.3. The History*

There is a vast literature on the appropriateness of aggregating over monetary asset components using simple summation. Linear aggregation can be based on Hicksian aggregation (Hicks 1946), but that theory only holds under the unreasonable assumption that the user-cost prices of the services of individual money assets do not change over time. This condition implies that each asset is a perfect substitute for the others within the set of components. Simple sum aggregation is an even more severe special case of that highly restrictive linear aggregation, since simple summation requires that the coefficients of the linear aggregator function all be the same. This, in turn, implies that the constant user-cost prices among monetary assets be exactly equal to each other. Not only must the assets be perfect substitutes, but must be perfect one-for-one substitutes --- i.e., must be indistinguishable assets, with one unit of each asset being a perfect substitute for exactly one unit of each of the other assets.

In reality, financial assets provide different services, and each such asset yields its own particular rate of return. As a result, the user costs, which measure foregone interest and thereby opportunity cost, are not constant and are not equal across financial assets. The relative prices of U.S. monetary assets fluctuate considerably, and the interest rates paid on many monetary assets are not equal to the zero interest rate paid on currency. These observations have motivated serious concerns about the reliability of the simple-sum aggregation method, which has been disreputable in the literature on index number theory and aggregation theory for over a century. In addition, an increasing number of imperfectly substitutable short-term financial assets have emerged in recent decades. Since monetary aggregates produced from simple summation do not accurately measure the quantities of monetary services chosen by optimizing agents, shifts in the series can be spurious, as those shifts do not necessarily reflect a change in the utility derived from money holdings.

Microeconomic aggregation theory offers an appealing alternative approach to the definition of money, compared to the atheoretical simple-sum method. The quantity index under the aggregation-theoretic approach extracts and measures the income effects of changes in relative prices and is invariant to substitution effects, which do not alter utility and thereby do not alter perceived services received. The simple sum index, on the other hand, does not distinguish between income and substitution effects, and thereby the simple sum index confounds together substitution effects with actual services received. The aggregation-theoretic monetary aggregator function, which correctly internalizes substitution effects, can be tracked accurately by the Divisia quantity index, constructed by using expenditure shares as the component growth-rate weights. Barnett (1978,1980) derived the formula for the theoretical user-cost price of a monetary asset, needed in computation of the Divisia index's share weights, and thereby originated the Divisia monetary aggregates. The growth rate weights resulting from this approach are different across assets, depending on all of the quantities and interest rates in each share, and those weights can be time-varying at each point in time. For a detailed description of the theory underlying this construction, see Barnett (1982, 1987).

The Divisia index is the weighted average of the growth rates of the components, with the weights being the expenditure shares on the components. The shares are computed with user cost prices, where the user cost prices are foregone interest rates with foregone interest measured as the difference between the rate of return on a pure investment, called the benchmark asset, and the own rate of return on the component asset. It is important to understand that the direction in which an asset's growth-rate weight will change with an interest rate change is not predictable in advance. Consider Cobb-Douglas utility. Its shares are independent of relative prices, and hence of the interest rates within the component user-cost prices. For other utility functions, the direction of the change in shares with a price change, or equivalently with an interest rate change, depends upon whether the own price elasticity of demand exceeds or is less than -1. In elementary microeconomic theory, this often overlooked phenomenon produces the famous "diamonds versus water paradox" and is the source of most of the misunderstandings of the Divisia monetary aggregates' weighting, as explained by Barnett (1983).

Several authors have studied the empirical properties of the Divisia index compared with the simple sum index. The earliest comparisons are in Barnett (1982) and Barnett, Offenbacher, and Spindt (1984). Barnett and Serletis (2000) collect together and reprint seminal journal articles from this literature.[3] Barnett (1997) has documented the connection between the well-deserved decline in the policy-credibility of monetary aggregates and the defects that are peculiar to simple sum aggregation.

The most recent research in this area is Barnett, Chauvet, and Tierney (2008), who compare the different dynamics of simple-sum monetary aggregates and the Divisia indexes, not only over time, but also over the business cycle and across high and low inflation and interest rate phases. Information about the state of monetary growth becomes particularly relevant for policymakers, when inflation enters a high-growth phase or the economy begins to weaken. Factor models with regime switching have been widely used to represent business cycles (see e.g., Chauvet (1998, 2001), Kim and Nelson (1998), among several others), but without relationship to aggregation theory. Barnett, Chauvet, and Tierney's proposed model differs from the literature in its complexity, as it includes estimation of the parameters of three independent Markov processes. In addition, the focus is not only on the estimated common factor, but on

[3] More recent examples include Belongia (1996), Belongia and Ireland (2006), and Schunk (2001), and the comprehensive survey found in Barnett and Serletis (2000). Other overviews of published theoretical and empirical results in this literature are available in Barnett, Fisher, and Serletis (1992) and Serletis (2006).

the idiosyncratic terms that reflect the divergences between the simple sum and Divisia monetary aggregate indexes in a manner relevant to aggregation theory.

# 2. Monetary Aggregation Theory

### *2.1. Monetary Aggregation*

Aggregation theory and index-number theory have been used to generate official governmental data since the 1920s. One exception still exists. The monetary quantity aggregates supplied by most central banks are the simple unweighted sums of the component quantities, while the interest rate aggregates are the quantity-weighted or arithmetic averages of interest rates. Neither is based on valid index number or aggregation theory. The predictable consequence has been induced instability of money demand and supply functions, and a series of 'puzzles' in the resulting applied literature. In contrast, the Divisia monetary aggregates are derived directly from economic index-number theory. Financial aggregation and index number theory was first rigorously connected with the literature on microeconomic aggregation and index-number theory by Barnett (1980; 1987).

Data construction and measurement procedures imply the theory that can rationalizes the aggregation procedure. The assumptions implicit in the data construction procedures must be consistent with the assumptions made in producing the models within which the data are to be used. Unless the theory is internally consistent, the data and its applications are incoherent. Without that coherence between aggregator-function structure and the econometric models within which the aggregates are embedded, stable structure can appear to be unstable. This phenomenon has been called the "Barnett critique" by Chrystal and MacDonald (1994).

We assume that the readers are familiar with the relevant theory, including Barnett's Divisia monetary aggregation formula. Those unfamiliar with the theory are referred to the survey of that theory in Barnett and Chauvet (2008).

### *2.1. The History of Thought on Monetary Aggregation*

The field of aggregation and index number theory has a long history, going back for about a century. The first book to put together the properties of all of the available index numbers in a systematic manner was the famous book by Irving Fisher (1922). He made it clear in that book that the simple sum and arithmetic average indexes are the worst known indexes. On p. 29 of that book he wrote:

> "The simple arithmetic average is put first merely because it naturally comes first to the reader's mind, being the most common form of average. In fields other than index numbers it is often the best form of average to use. But we shall see that the simple arithmetic average produces one of the very worst of index numbers, and if this book has

no other effect than to lead to the total abandonment of the simple arithmetic type if index number, it will have served a useful purpose."

On p. 361 Fisher wrote:

> "The simple arithmetic should not be used under any circumstances, being always biased and usually freakish as well. Nor should the simple aggregative ever be used; in fact this is even less reliable."

Modern statistical index number theory is frequently viewed relative to Diewert's (1976) work on superlative index number theory connecting statistical index numbers with the aggregator functions of microeconomic aggregation theory through second order approximations. That theory becomes immediately relevant to financial aggregation with the derivation of the user-cost formula for monetary services in Barnett (1980).

# 3. The 1960s and 1970s

We now survey some key results regarding the historical misperceptions from the 1960s to the present time. We organize them chronologically, to make the evolution of views clear. The source of the results in this section regarding the 1960s and 1970s, along with further details, can be found in Barnett, Offenbacher, and Spindt (1984) and Barnett (1982).

Demand and supply of money functions were fundamental to macroeconomics and to central bank policy until the 1970s, when questions began to arise about the stability of those functions. It was common for general equilibrium models to determine real values and relative prices, and for the demand and supply of money to determine the price level and thereby nominal values. But it was believed that something went wrong in the 1970s. In Figure 1, observe the behavior of the velocity of M3 and M3+ (later called L), which were the two broad aggregates often emphasized in that literature. For the demand for money function to have the correct sign for its interest elasticity, velocity must move in the same direction as nominal interest rates.

Figure 2 displays an interest rate during that time period. Note that while nominal interest rates were increasing during the increasing inflation of that decade, the velocities of the simple sum monetary aggregates in Figure 1 were decreasing. While the source of the resulting concern is evident, note that the problem did not arise, when the data were produced from index number theory. The interest elasticity of velocity was positive for all three plots produced from index number theory.

*Figure 1*:  Seasonally adjusted normalized velocity during the 1970s

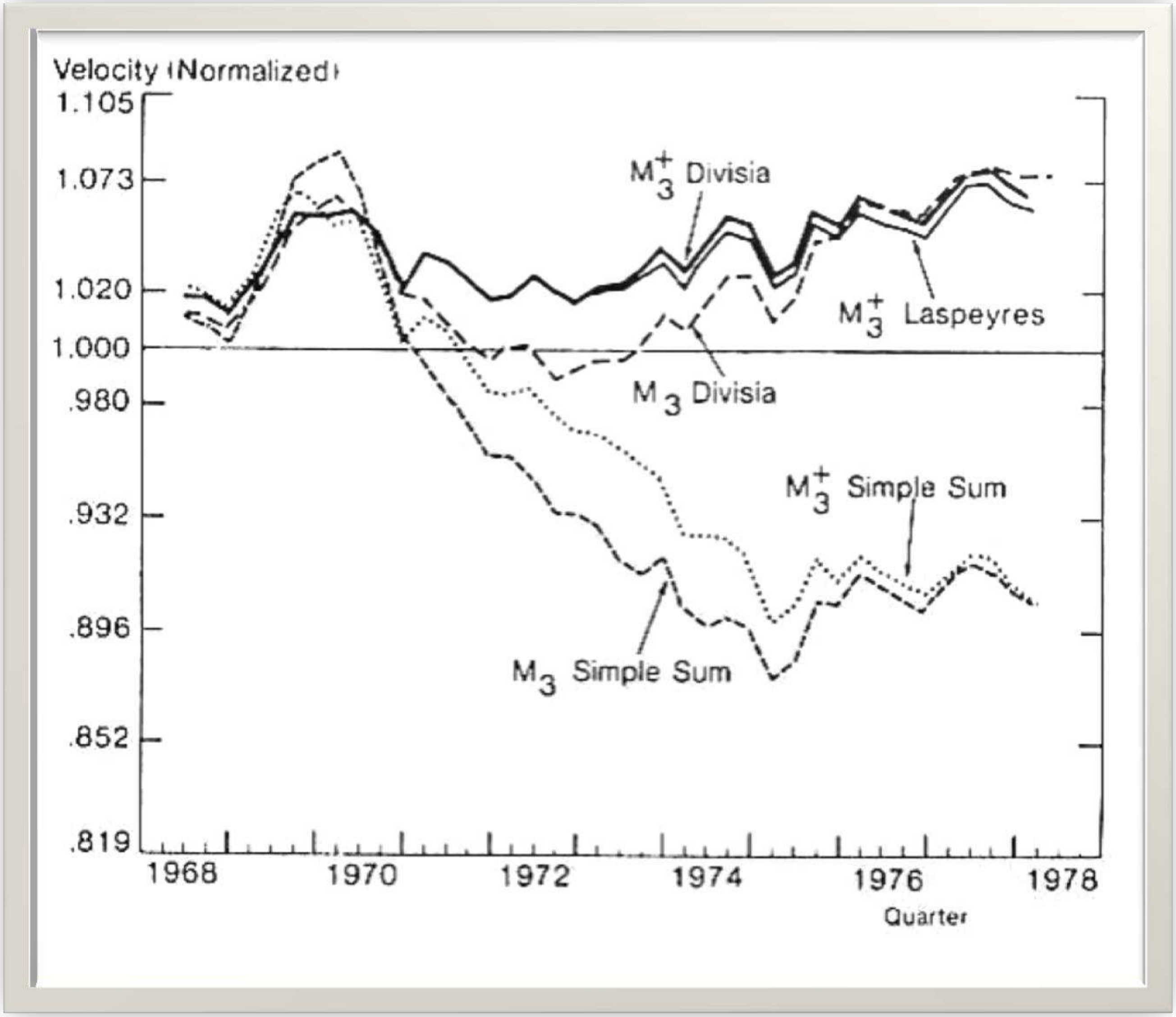
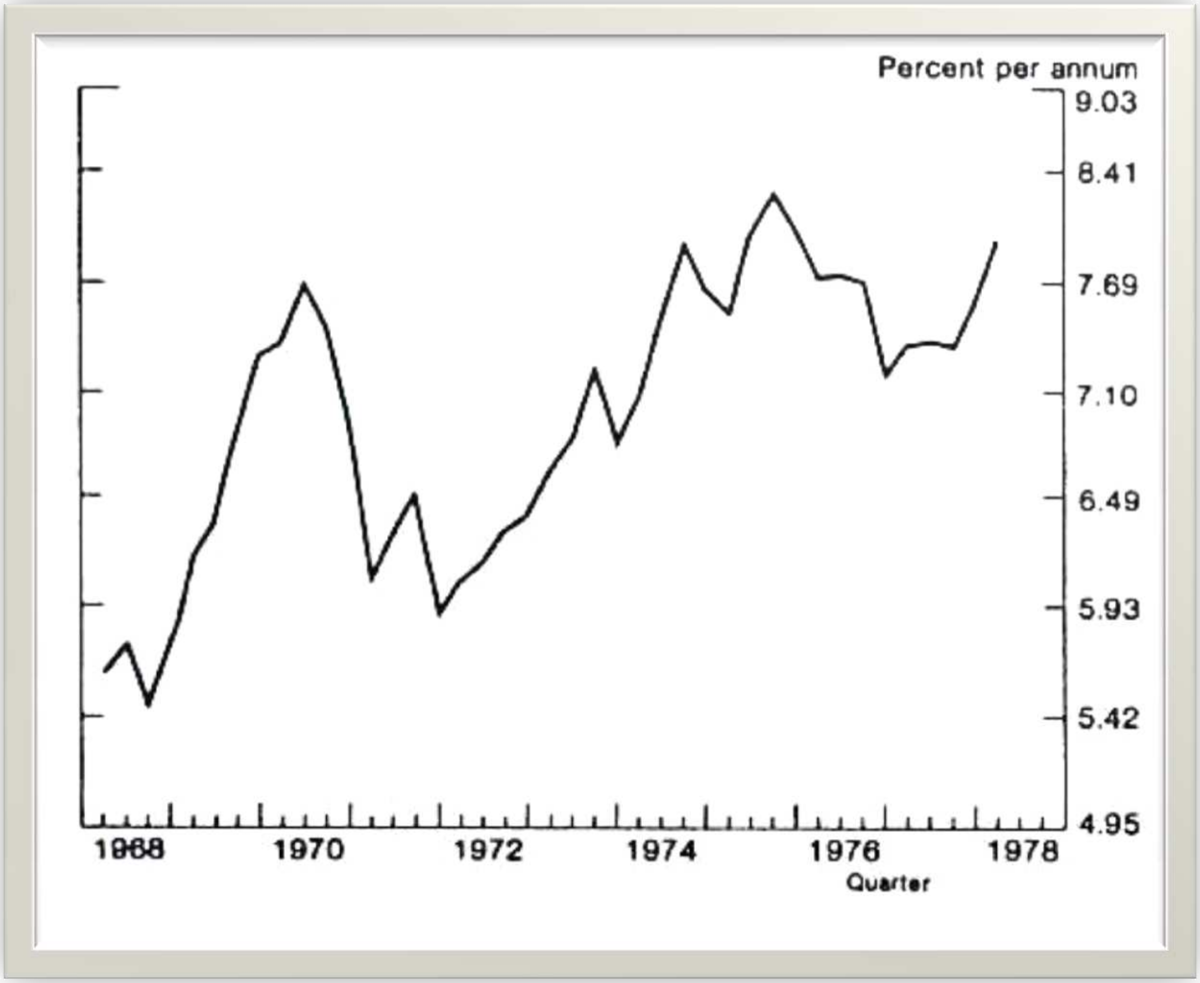


*Figure 2*: Interest Rates during the 1970s: 10 year government bond rate




Most of the concern in the 1970s was focused on 1974, when it was believed that there was a sharp structural shift in money markets. Figure 3 displays a source of that concern. In figure 3, we have plotted velocity against a bond rate, rather than against time, as in Figure 1. As is evident from Figure 3, there appears to be a dramatic shift downwards in that velocity function in 1974. But observe that this result was acquired using simple sum M3. Figure 4 displays the same cross plot of velocity against an interest rate, but with M3 computed as its Divisia index. Observe that velocity no longer is constant, either before or after 1974. But there is no structural shift.

There were analogous concerns about the supply side of money markets. The reason is evident from Figure 5, which plots the base multiplier against a bond rate's deviation from trend. The base multiplier is the ratio of a monetary aggregate to the monetary base. In this case, the monetary aggregate is again simple sum M3. Observe the dramatic structural shift. Prior to 1974, the function was a parabola. After 1974 the function is an intersecting straight line. But again this puzzle was produced by the simple sum monetary aggregate. In Figure 6, the same plot is provided, but with the monetary aggregate changed to Divisia M2. The structural shift is gone.

*Figure 3*: Simple Sum M3 Velocity versus Interest Rate: Moody's AAA corporate bond rate, quarterly, 1959.1-19980.3

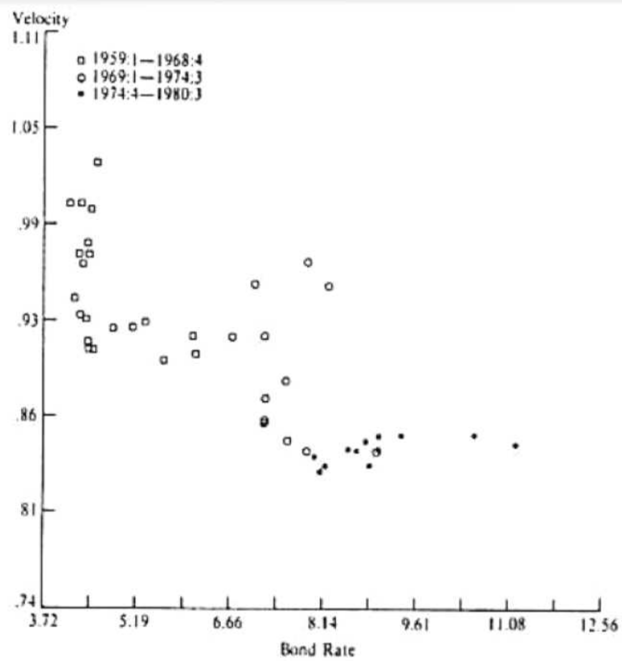


*Figure 4*:  Divisia M3 Velocity versus Interest Rate:  Moody's AAA corporate bond rate, quarterly, 1959.1-19980.3

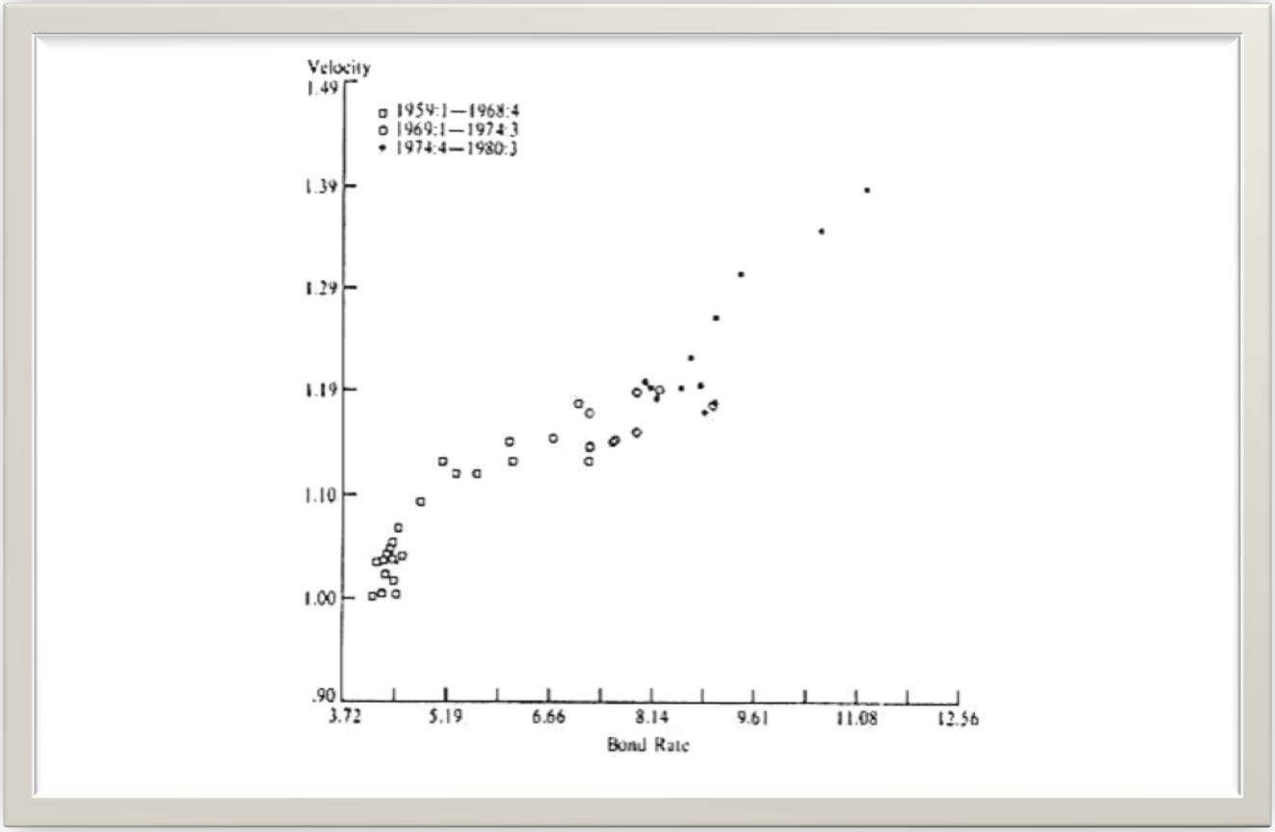


*Figure 5*:  Simple Sum M3 Base Multiplier versus Interest Rate:  deviation from time trend of Moody's Baa corporate bond rate, monthly 1969.1-1981.8.

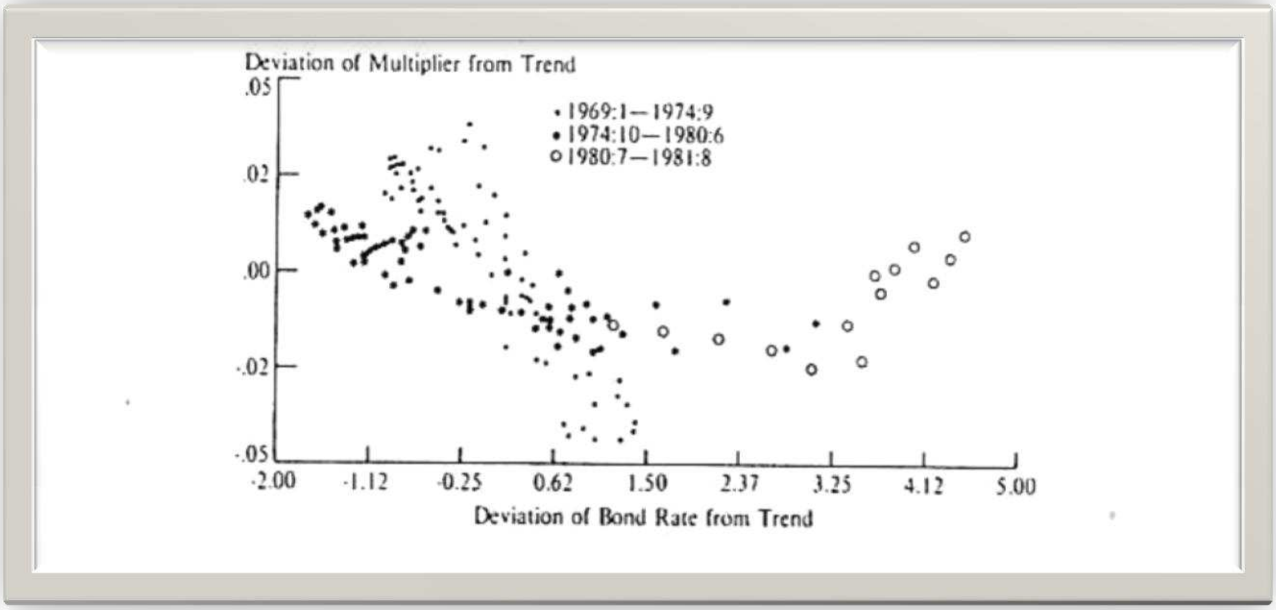
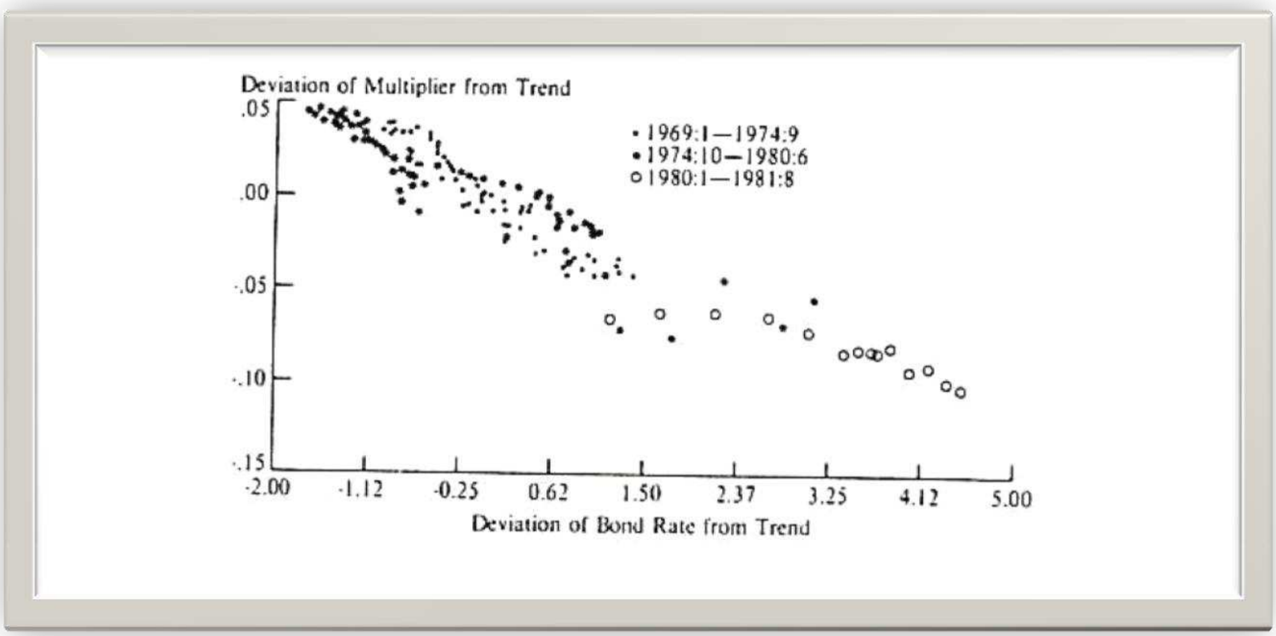



*Figure 6*:  Divisia M3 Monetary Aggregate Base Multiplier versus Deviation from time trend of Moody's Baa corporate bond Interest Rate, monthly 1969.1-1981-8.



The most formal methods of investigating these concerns at the time were based on the use of the Goldfeld (1973) demand for money function, which was the standard specification used by the Federal Reserve System. The equation was a linear function of a monetary aggregate on national income, a regulated interest rate, and an unregulated interest rate. It was widely believed that the function had become unstable in the 1970s. At the time, I requested the Board's staff to see if that would remain true, when the left hand side was the corresponding Divisia monetary aggregate.

P.A.V.B. Swamy and Peter Tinsley (1980), at the Federal Reserve Board, had produced a stochastic coefficients approach to estimating a linear equation. The result was an estimated stochastic process for each coefficient. The approach permitted testing the null hypothesis that all of the stochastic processes are constant. Swamy estimated the processes for the model's three coefficients with quarterly data from 1959:2 – 1980:4, and the results were published by Barnett, Offenbacher, and Spindt (1984), who also were at the Federal Reserve Board at that time. The realizations of the three coefficient processes are displayed in Figures 7, 8, and 9. The solid line is the process's realization, when money is measured by simple sum M2. The dotted line is the realization, when the monetary aggregate is measured by the Divisia index. The instability of the coefficient is very clear, when the monetary aggregate is simple sum, but the processes look like noise around a constant, when the monetary aggregate is Divisia. The statistical test could not reject constancy (i.e., stability of the demand for money function), when Divisia was used. But stability was rejected, when the monetary aggregate was simple sum.

*Figure 7*:  Income Coefficient Time Path

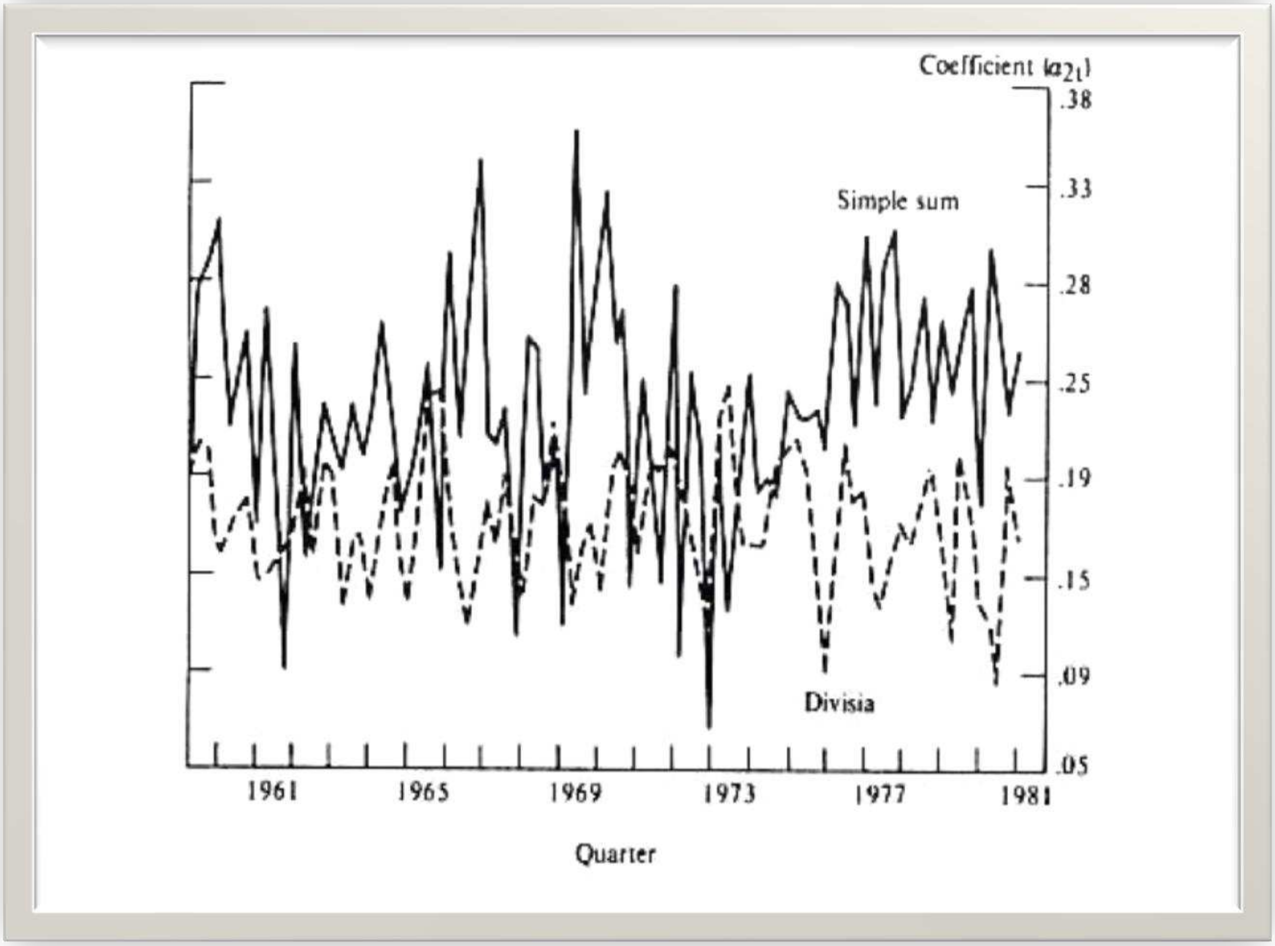


*Figure 8*:  Market Interest Rate (commercial paper rate) Coefficient Time Path

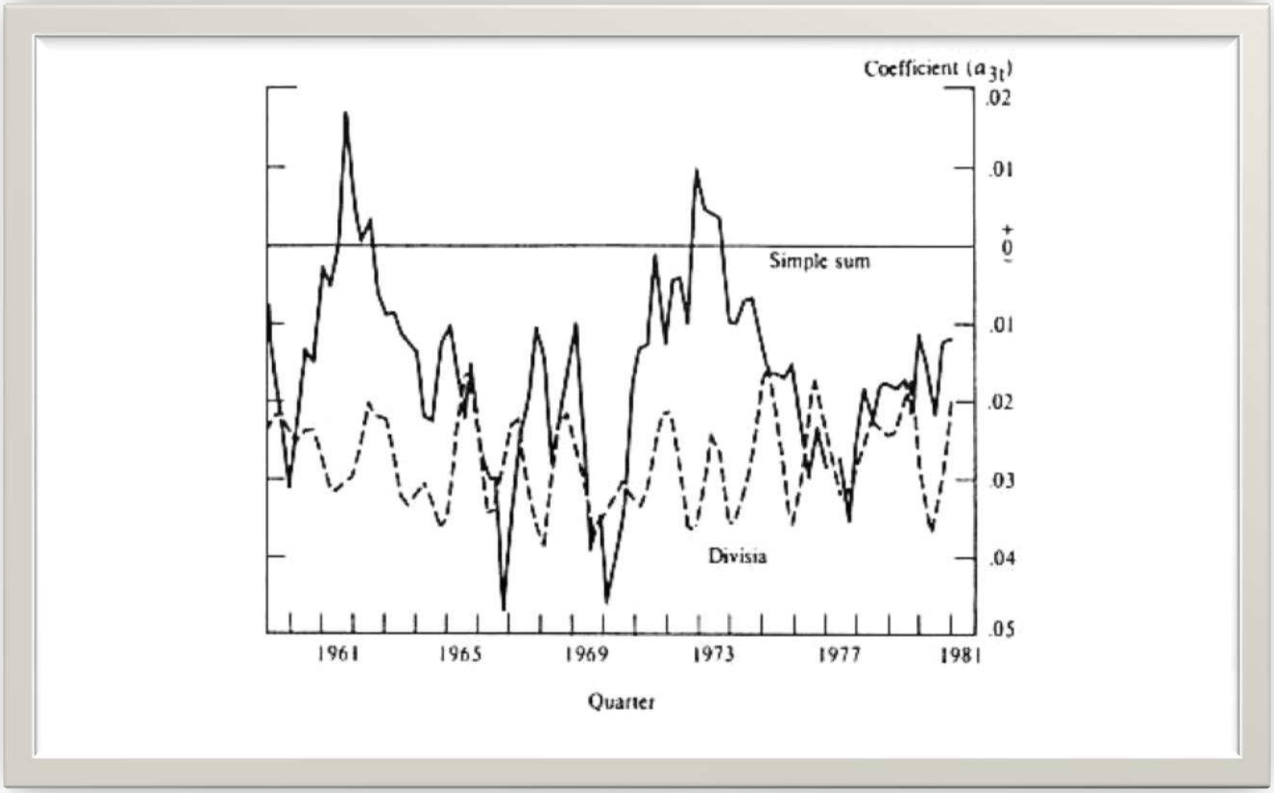
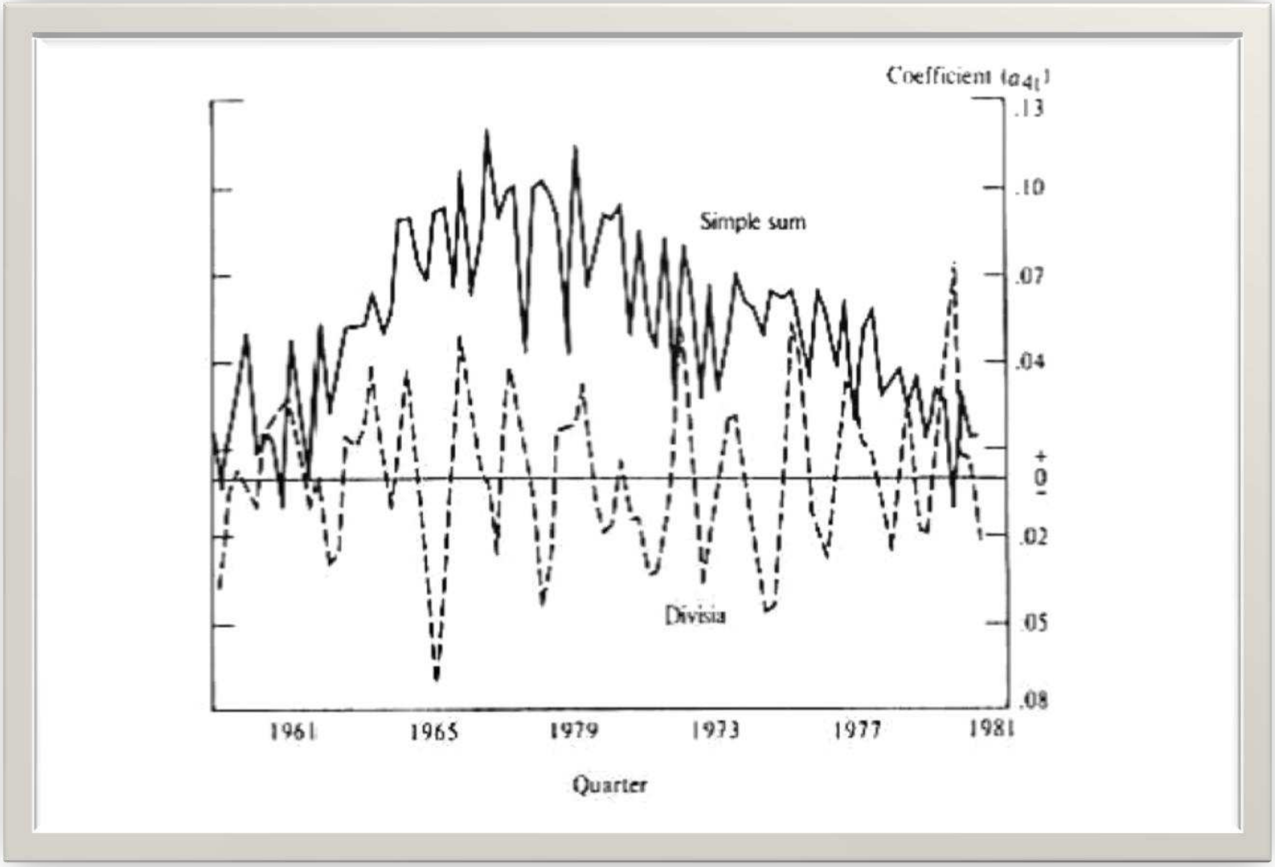


*Figure 9*: Regulated Interest Rate (passbook rate) Coefficient Time Path

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## 4. The Monetarist Experiment: November 1979 – November 1982.

Following the inflationary 1970s, Paul Volcker, as Chairman of the Federal Reserve Board, decided to bring inflation under control by decreasing the rate of growth of the money supply, with the instrument of policy being changed from the federal funds rate to nonborrowed reserves. The period, November 1979 – November 1982, during which that policy was applied, was called the "Monetarist Experiment." The policy succeeded in ending the escalating inflation of the 1970s, but was followed by an unintended recession. The Federal Reserve had decided that the existence of widespread 3-year negotiated wage contracts precluded a sudden decrease in the money supply growth rate to the intended long run growth rate. The decision was to decrease from the high double-digit growth rates to about 10% per year and then gradually to decrease towards the intended long run growth rate.

It was believed that a sudden drop to the desired long run growth rate would produce a recession. Figures 10 and 9 and Table 1 from Barnett (1984) reveal the cause of the unintended recession. As is displayed in Figures 10 and 11, for the M2 and M3 levels of aggregation, the rate of growth of the Divisia monetary aggregates was less than the rate of growth of the official simple sum aggregate intermediate targets. As Table 1 summarizes, the simple sum aggregate growth rates were at the intended levels, but the Divisia growth rates were half as large, producing an unintended negative shock of substantially greater magnitude than intended. When a recession occurred, that unintended consequence was an embarrassment to monetarists, who subsequently denied that a monetarist policy actually had been in effect. But it is well known to those who were on the staff of the Federal Reserve Board at the time that the Federal Reserve was doing what it said it was doing.

*Figure 10*: Seasonally adjusted annual M2 Growth Rates. Solid line = Divisia, dashed line = simple sum. The last three observations to the right of the vertical line are post sample period.

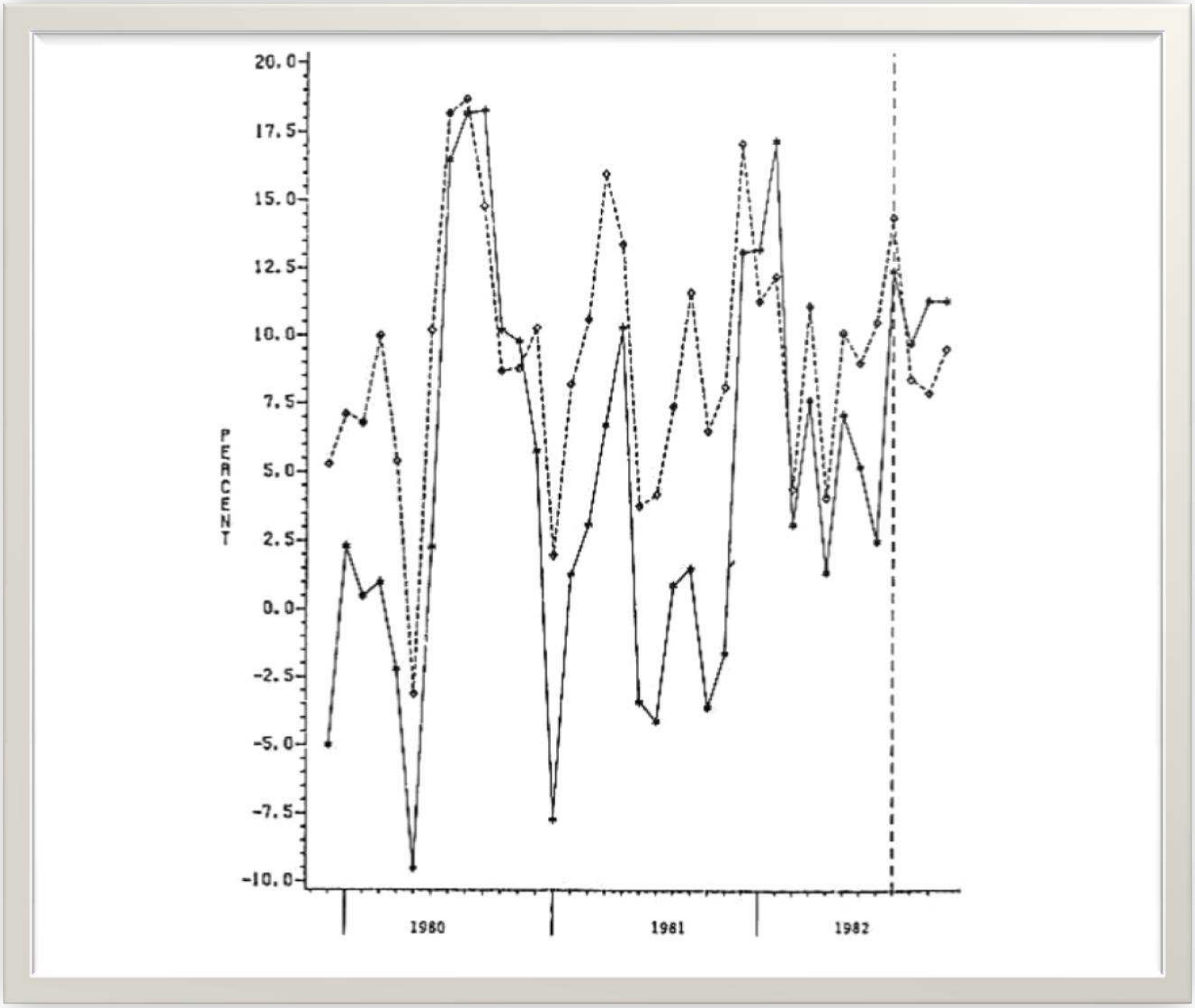


*Figure 11*: Seasonally adjusted annual M3 Growth Rates. Solid line = Divisia, dashed line = simple sum. The last three observations to the right of the vertical line are post sample period.

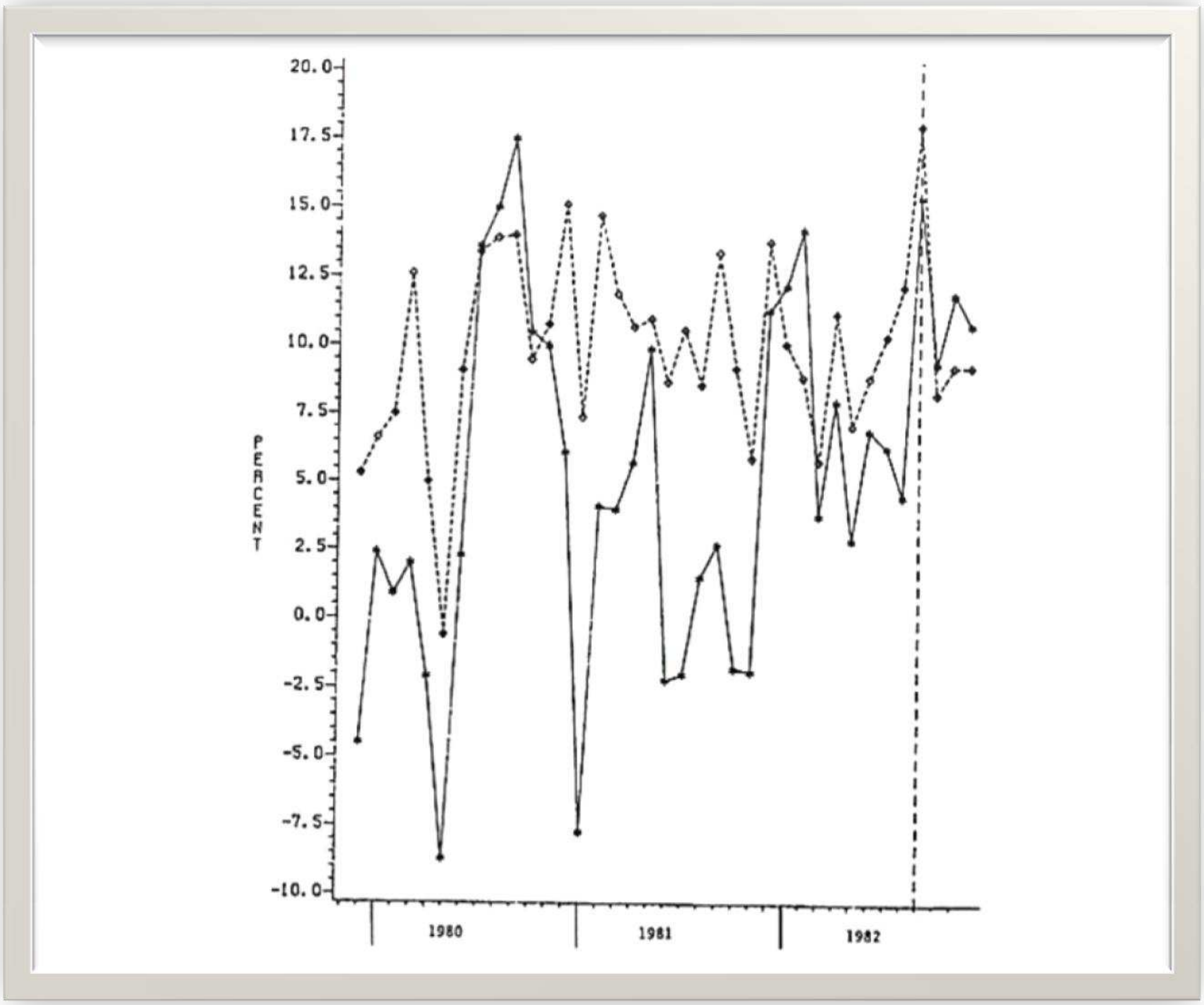


*Table 1*: Mean Growth Rates During the Period

| Monetary Aggregate | Mean Growth Rate during Period |
|---|---|
| Divisia M2 | 4.5 |
| Simple Sum M2 | 9.3 |
| Divisia M3 | 4.8 |
| Simple Sum M3 | 10.0 |

## 5. End of the Monetarist Experiment: 1983 - 1984

Following the end of the Monetarist Experiment and the unintended recession that followed, Milton Friedman became very vocal with his prediction that there had been a huge surge in the growth rate of the money supply, and that surge would surely work its way through the economy and produce a new inflation. He further predicted that there would be an overreaction by the Federal Reserve, plunging the economy back down into a recession. He published this view repeatedly in the media in various magazines and newspapers, with the most visible being his *Newsweek* article that appeared on September 26, 1983. That article is provided in the Appendix in Figure A1.

We have excerpted some of the sentences from that *Newsweek* article below:

> "The monetary explosion from July 1982 to July 1983 leaves no satisfactory way out of our present situation. The Fed's stepping on the brakes will appear to have no immediate effect. Rapid recovery will continue under the impetus of earlier monetary growth. With its historical shortsightedness, the Fed will be tempted to step still harder on the brake – just as the failure of

> rapid monetary growth in late 1982 to generate immediate recovery led it to keep its collective foot on the accelerator much too long. The result is bound to be renewed stagflation – recession accompanied by rising inflation and high interest rates... The only real uncertainty is when the recession will begin."

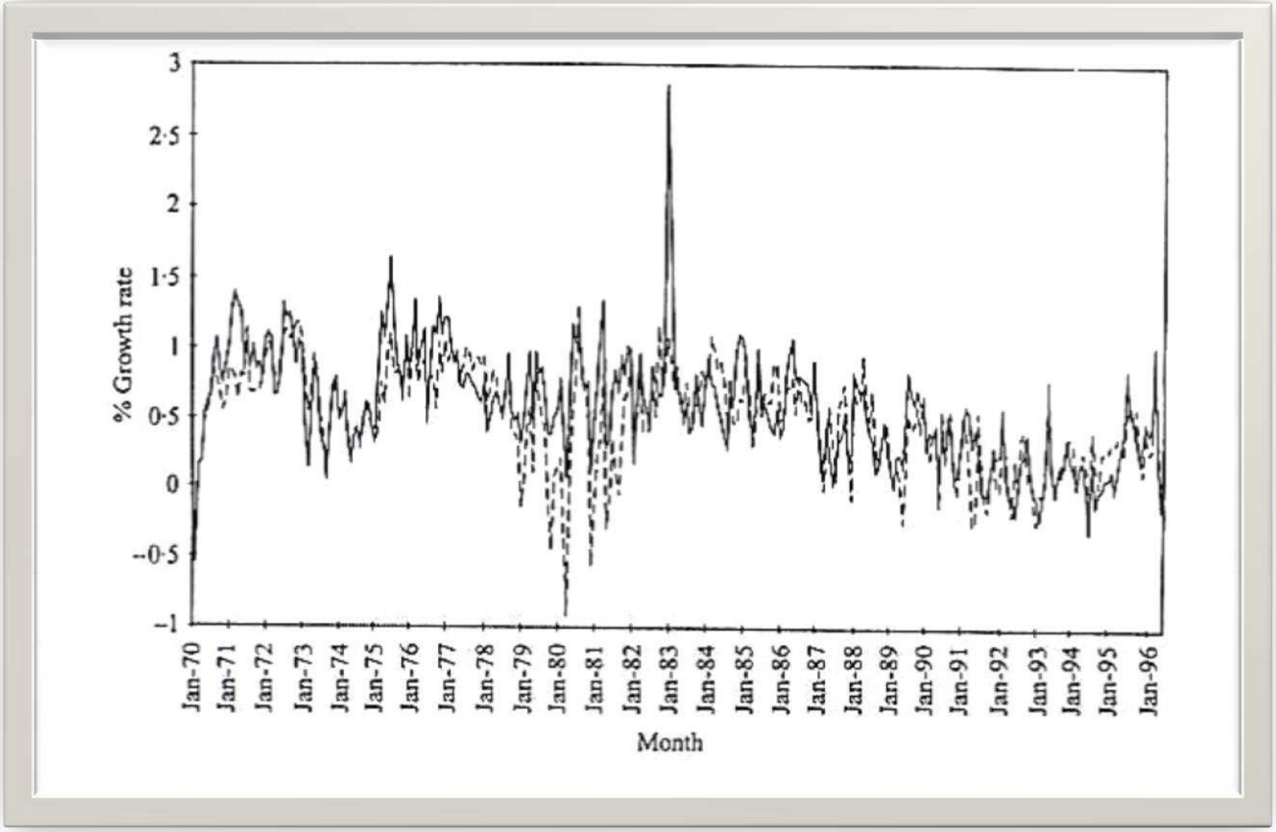
But on exactly the same day, September 26, 1983, William Barnett published a very different view in *Forbes* magazine. That article is reprinted in the Appendix as Figure A2. The following is an excerpt of some of the sentences from that article:

> "people have been panicking unnecessarily about money supply growth this year. The new bank money funds and the super NOW accounts have been sucking in money that was formerly held in other forms, and other types of asset shuffling also have occurred. But the Divisia aggregates are rising at a rate not much different from last year's... the 'apparent explosion' can be viewed as a statistical blip."

Of course, Milton Friedman would not have taken such a strong position without reason. You can see the reason from Figure 12. The percentage growth rates in that figure are divided by 10, so should be multiplied by 10 to acquire the actual growth rates. Notice the large spike in growth rate, rising to near 30% per year. But that solid line is produced from simple sum M2, which was greatly overweighting the recent new availability of super NOW accounts and money market deposit accounts. There was no spike in the Divisia monetary aggregate, represented by the dashed line.

If indeed the huge surge in the money supply had occurred, then inflation would surely have followed, unless money is extremely non-neutral, a view held by very few economists. There was no inflationary surge and no subsequent recession.

*Figure 12*: Monetary Growth Rates, 1970-1996, from St. Louis Federal Reserve's Database

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## 6. The Rise of Risk Adjustment Concerns: 1984 - 1993

The Divisia index tracks the aggregator function measuring monetary service flow. But for some purposes, the economic capital stock, computed from the discounted expected future service flow, is relevant, especially when investigating wealth effects of policy. The economic stock of money (ESM), as defined by Barnett (2000) under perfect foresight, follows immediately from the manner in which monetary assets are found to enter the derived wealth constraint.

During the late 1980s and early 1990s, there was increasing concern about substitution of monetary assets with stock and bond mutual funds, which are not within the monetary aggregates. The Federal Reserve Board staff considered the possibility of incorporating stock and bond mutual funds into the monetary aggregates. Barnett and Zhou (1994) used Barnett's formula for the ESM to investigate the problem. They produced the figures that we reproduce below as Figures 16-19. The dotted line is the simple sum monetary aggregate, which Barnett (2000) proved is equal to the sum of economic capital stock of money, $V_t$, and the discounted expected investment return from the components. Hence the simple sum aggregate confounds together the monetary part of the stock with the nonmonetary investment part within the joint product that is measured by the simple sum aggregate.

Computation of $V_t$ requires modeling expectations. In that early paper, Barnett and Zhou (1994) used martingale expectations rather than the more recent approach of Barnett, Chae, and Keating (2006), using VAR forecasting. When martingale expectations are used, the index is called CE. Since the economic capital stock of money, $V_t$, is the stock that is relevant to macroeconomic theory, we should concentrate on the solid lines in those figures. Note that Figure 14 displays nearly parallel time paths, so that the growth rate is about the same in either. That figure is for M2+, which was the Federal Reserve Board staff's proposed extended aggregate, adding stock and bond mutual funds to M2. But note that in Figure 13, the gap between the two graphs is decreasing, producing a slower rate of growth for the simple sum aggregate than for the economic stock of money.

The reason can be found in Figures 15 and 16, which use a solid line to display the monetary (i.e., liquidity) services from stock and bond mutual funds and a dotted line for simple sum measure of those funds. Recall that the simple sum measures a joint product: the discounted investment yield plus the discounted service flow. Hence the gap between the two lines is the amount motivated by investment yield. Clearly those gaps have been growing. But it is precisely that gap which does *not* measure monetary services. By adding the value of stock and bond mutual funds into Figure 13 to get Figure 14, the growth rate error of the simple sum aggregate is offset by adding in an increased amount of assets providing nonmonetary services. Rather than trying to stabilize the error gap by adding in more and more nonmonetary services, the correct solution would be to remove the entire error gap by using the solid lines in Figures 13 and 14, which measure the actual capital stock of money.

*Figure 13*: M2 Joint Product and Economic Capital Stock of Money. M2=simple sum joint product; CEM2=economic capital stock part of the joint product.

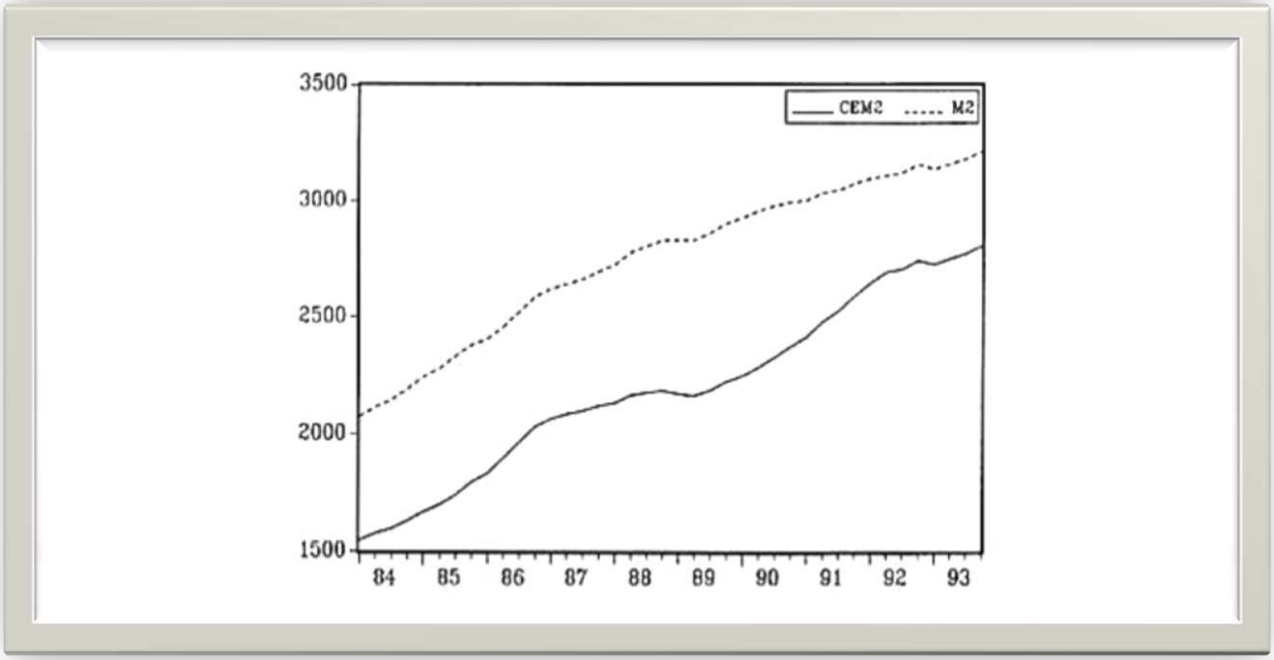


*Figure 14*: M2+ Joint Product and Economic Capital Stock of Money. M2+=simple sum joint product; CEM2+=economic capital stock part of the joint product.

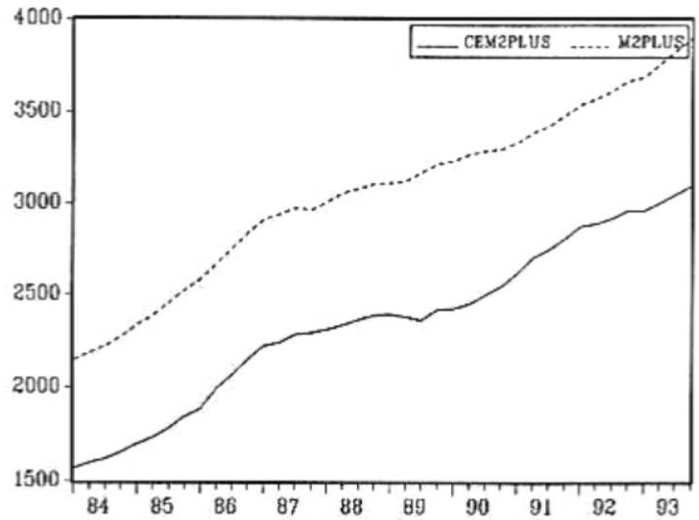



*Figure 15*: Common stock mutual funds joint product and their economic capital stock. StockQ=simple sum joint product; CEstock=economic capital stock part of the joint product.

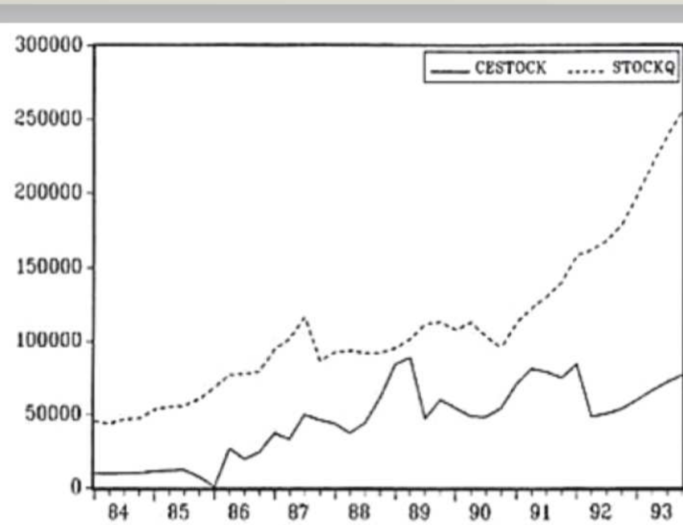
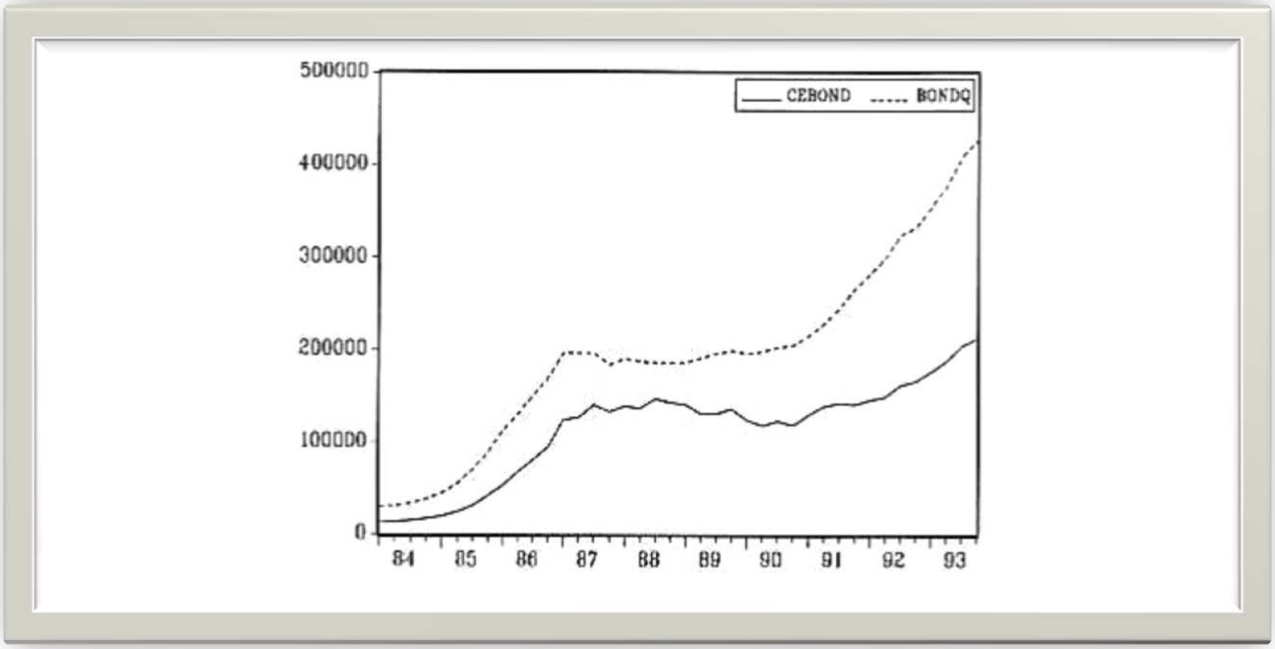


*Figure 16*: Bond mutual funds joint product and their economic capital stock. BondQ=simple sum joint product; CEbond=economic capital stock part of the joint product.

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## 7. The Y2K Computer Bug: 1999-2000

The next major concern about monetary aggregates and monetary policy appeared at the end of 1999. The financial press became highly critical of the Federal Reserve for what was perceived by those commentators to be a large, inflationary surge in the monetary base. The reason is clear from Figure 17. But in fact there was no valid reason for concern, since the cause was again a problem with the data.

The monetary base is the sum of currency plus bank reserves. Currency is dollar-for-dollar pure money, while reserves back deposits as a multiple of the reserves. Hence as a measure of monetary services, the monetary base is severely defective, even though it is a correct measure of "outside money." At the end of 1999, there was the so-called Y2K computer bug, which was expected to cause temporary problems with computers throughout the world, including at banks. Consequently many depositors withdrew funds from their checking accounts and moved them into cash. While the decrease in deposits thereby produced an equal increase in currency demand, the decrease in deposits produced a smaller decline in reserves, because of the multiplier from reserves to deposits. The result was a surge in the monetary base, even though the cause was a temporary dollar-for-dollar transfer of funds from demand deposits to cash, having little effect on economic liquidity. Once the computer bug was resolved, people put the withdrawn cash back into deposits, as is seen from Figure 18.

*Figure 17*: Monetary Base Surge

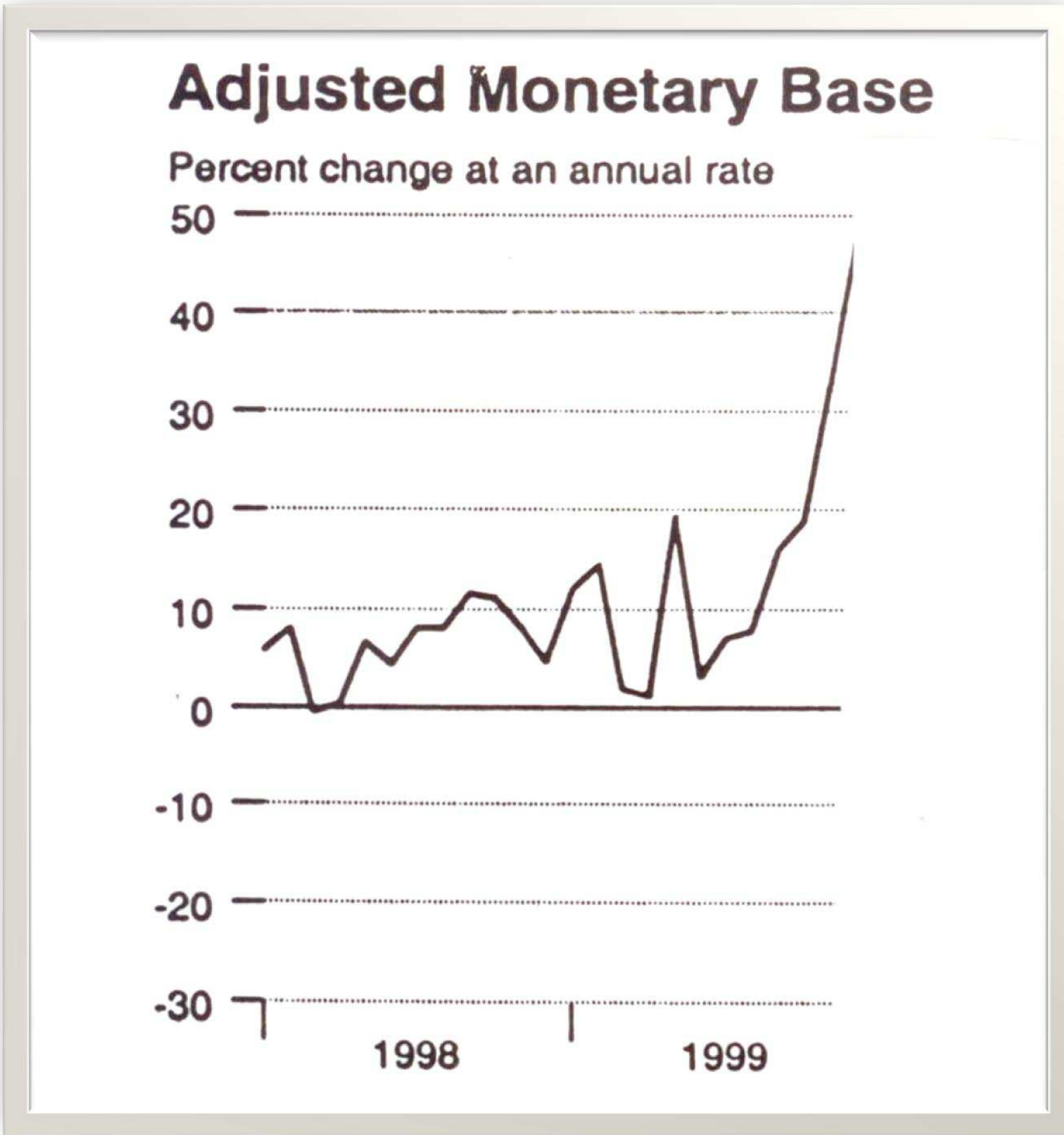
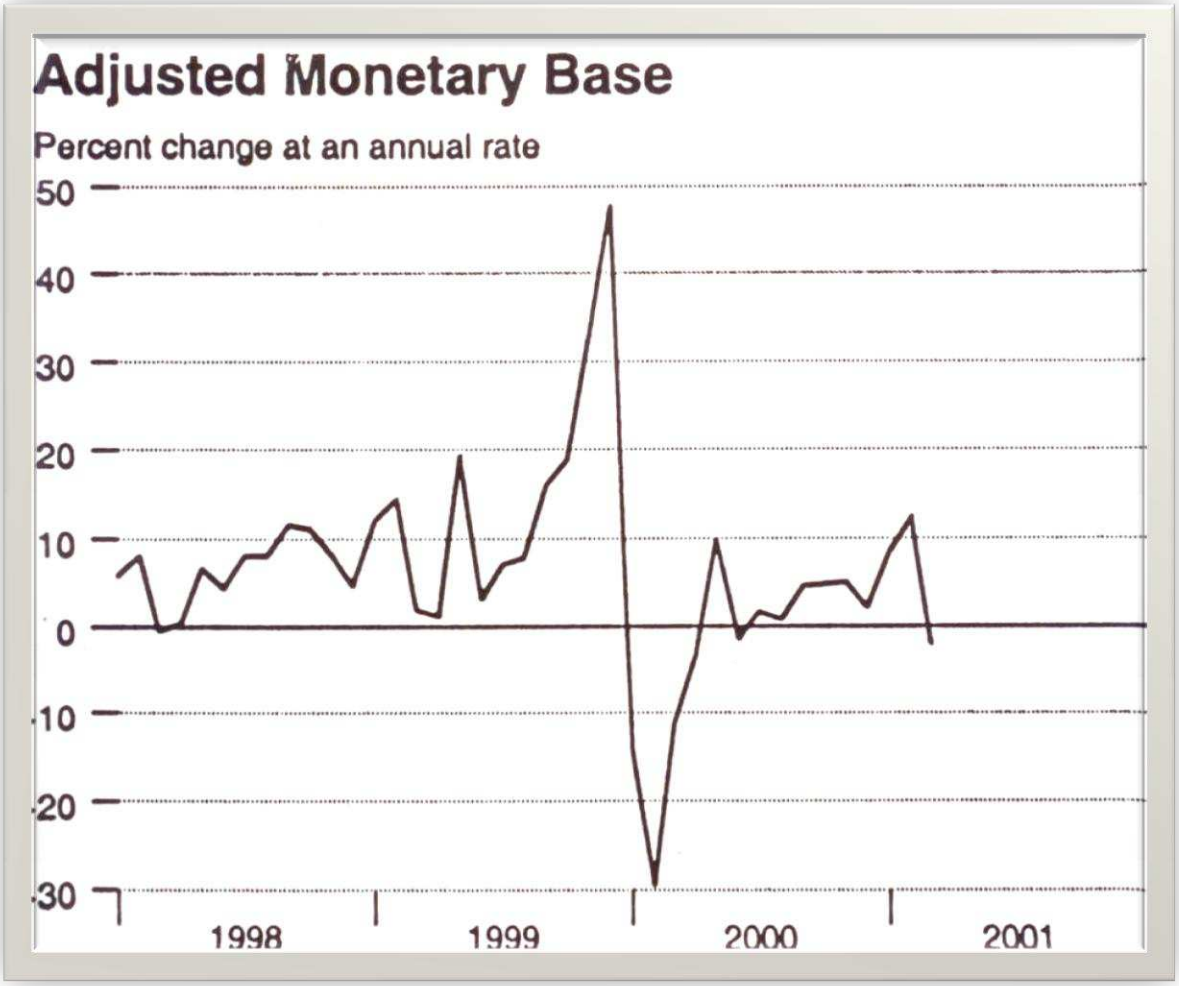


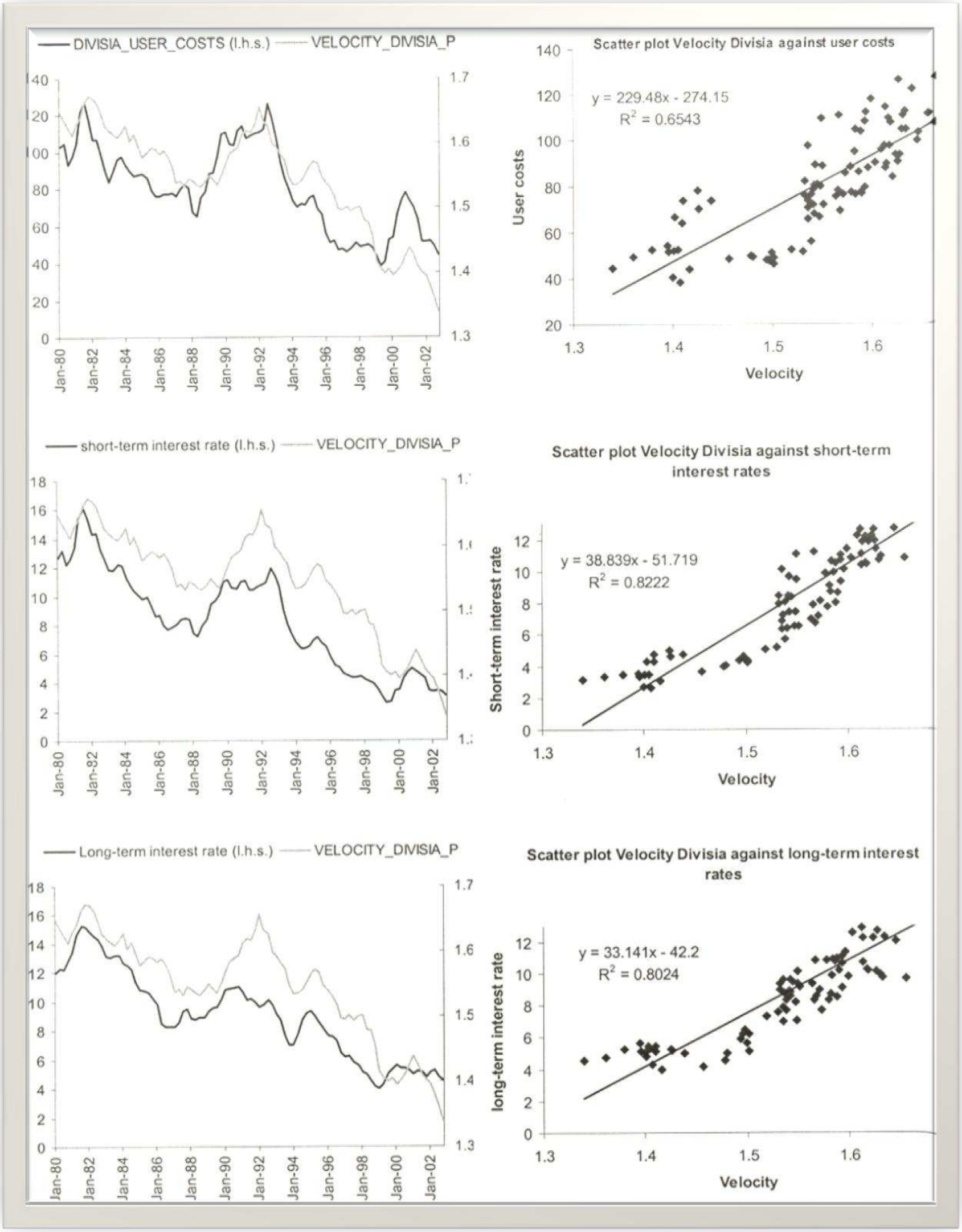
*Figure 18*: Y2K Computer Bug




## 8. European ECB Data

This survey concentrates on the experience in the US, where the theory of monetary aggregation originated. But the Bank of England and the European Central Bank now also have Divisia monetary aggregates, as have many central banks --- often available only for internal use. While the Bank of England makes its Divisia monetary aggregates public, the ECB does not (sadly not uncommon at many central banks throughout the world). However an economist on the staff of the ECB in Frankfurt provided to William Barnett the plots displayed in Figure 19 (without any implicit or explicit official authorization of publication from the ECB). The date was based upon the multilateral Divisia monetary aggregation theory produced for the ECB by Barnett (2007). While there is nothing "official" about Figure 19, the cross plots of velocity against an interest rate in that figure are interesting. Note the stable relationship, closely resembling that for the US displayed in Figure 4. Since the back data encompasses periods during which many non-euro currencies existed, and since even today many Europeans hold financial assets denominated in foreign currencies, such as the British pound, the multilateral approach produced by Barnett (2007) needs to be extended to the case of risky contemporaneous rates of return on money market assets, because of exchange rate risk. The theory for that extension, which could be incorporated into multilateral aggregation, is now available from Barnett and Wu (2005).

*Figure 19*: ECB Mondetary Velocity



## 9. The Most Recent Data: Would You Believe This?

The most recent research on this subject is Barnett, Chauvet, and Tierney (2008). It is a latent factor Markov-switching approach that separates out common dynamics from idiosyncratic terms. The dynamic factor measures the common cyclical movements underlying the observable variables. The idiosyncratic term captures movements peculiar to each index. The approach is used to provide pairwise comparisons of Divisia versus simple-sum monetary aggregates quarterly from 1960:2 to 2005:4. In that paper, they introduced the connection between the state-space time-series approach to assessing measurement error and the aggregation theoretic concept, with emphasis upon the relevancy to monetary aggregation and monetary policy.

We have provided below as Figure 20 one of the figures from that paper. The figure displays the idiosyncratic terms specific to Divisia M3 and simple sum M3. Compare Divisia M3's idiosyncratic downward spikes in Figure 20 with simple sum M3's idiosyncratic behavior and then compare the relative predictive ability of the two extracted idiosyncratic terms with respect to NBER recessions. Figure 20 speaks for itself. Divisia is much to be preferred to simple sum.

Considering this most recent result along with the others surveyed in this paper along with the relevant theory, based solidly on microeconomic aggregation theory, we find it informative to consider the most recent behavior of the Taylor rule, which does not use money at all. Figure 20 is reproduced from the St. Louis Federal Reserve Bank's publication, *Monetary Trends*. That figure displays the range of the target for the federal funds rate produced from the Taylor rule along with the actual interest rate over that time period, where the actual funds rate is the dark solid line. Notice that the actual interest rate was off target for more than three successive years. As we have observed, the paradoxes regarding the instability of the demand for money function disappear, when data based on aggregation theory is used. But perhaps we now have a real paradox: the evident instability of the Taylor rule.

As documented in this survey, monetary policy and monetary research have been plagued by extremely bad monetary aggregates data, resulting from simple sum aggregation, which has been disreputable to professional aggregation and index number theorist for over a half century. With so much history and evidence and so much research documenting the data problems, it might be assumed that central banks would now be taking much care to provide high quality data that is consistent with economic theory.

If that is what you would expect, then look at Figure 22, which was downloaded from the St. Louis Federal Reserve Bank web site and is produced from official Federal Reserve Board data in

Washington, DC.  Recall that during Volcker's "Monetarist Experiment" period, the instrument of policy was nonborrowed reserves.  Hence it is interesting to look at Figure 22, which displays official recent data on nonborrowed reserves from the Federal Reserve Board.

Total reserves are the sum of borrowed reserves and nonborrowed reserves.  Nonborrowed reserves are those reserves that were not borrowed, while borrowed reserves are those reserves that were borrowed.  Clearly everything included in borrowed reserves must be reserves, and everything contained in nonborrowed reserves must be reserves.  More formally,  everything included in borrowed and nonborrowed reserves must be subsets of total reserves.  Hence it is impossible for either borrowed reserves or nonborrowed reserves to exceed total reserves.  A negative value for either borrowed reserves or nonborrowed reserves would be an oxymoron.

Now look at Figure 22.  Observe that nonborrowed reserves recently have crashed to about minus 50 billion dollars.  The Federal Reserve's explanation is that they are including the new TAFs auction borrowing from the Federal Reserve in nonborrowed reserves, even though they need not be held as reserves.  Hence according to this terrible "data," the instrument of monetary policy during Volcker's Monetarist Experiment period now has been driven to a very negative value, as is impossible by the definition of nonborrowed reserves.  We doubt that even Joseph Stalin would have reported such distorted data based upon incompetent accounting.

*Figure 20*: Idiosyncratic terms for M3 (red) and Divisia M3 growth (blue), High Interest Rate Phases (green), High Inflation Phases (black), and NBER Recessions (shaded area).

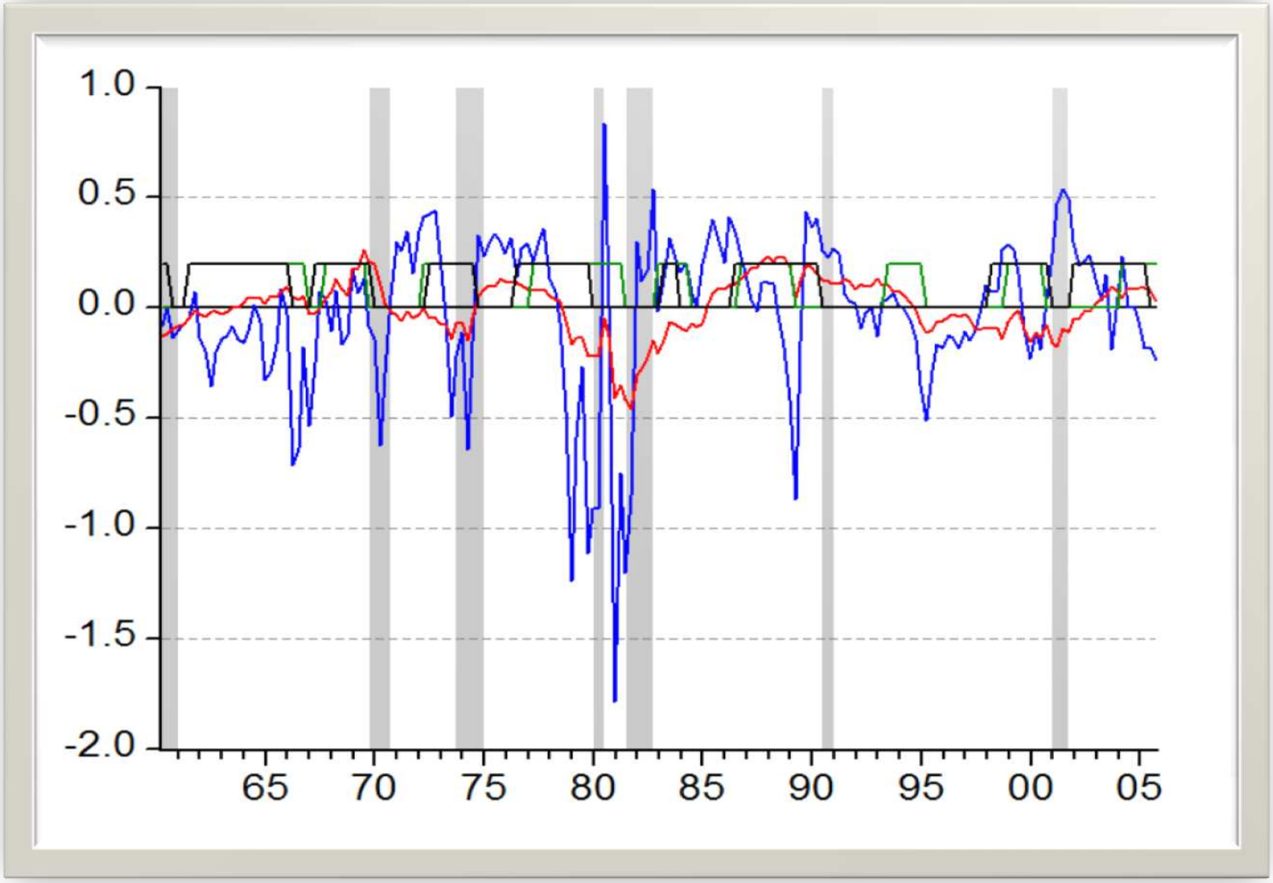


*Figure 21*:  Taylor Rule Federal Funds Rate

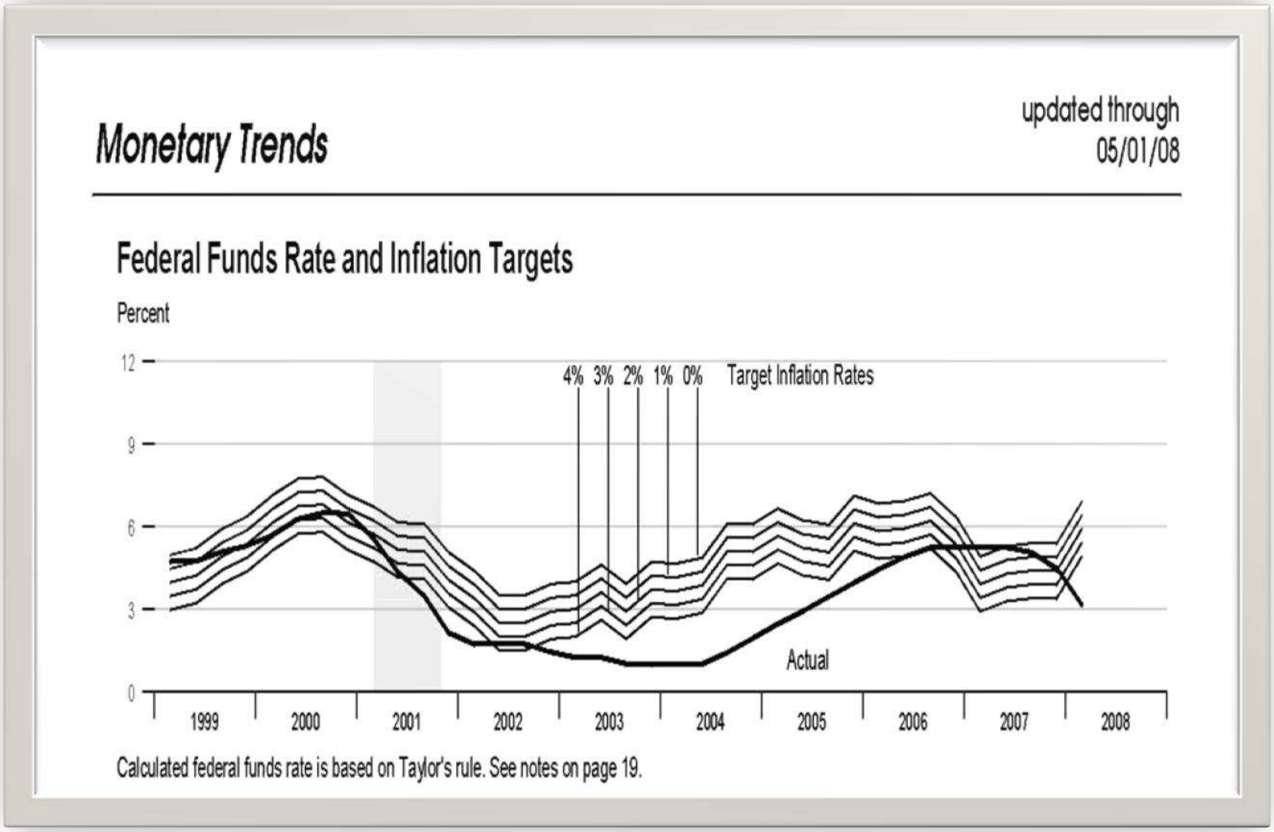
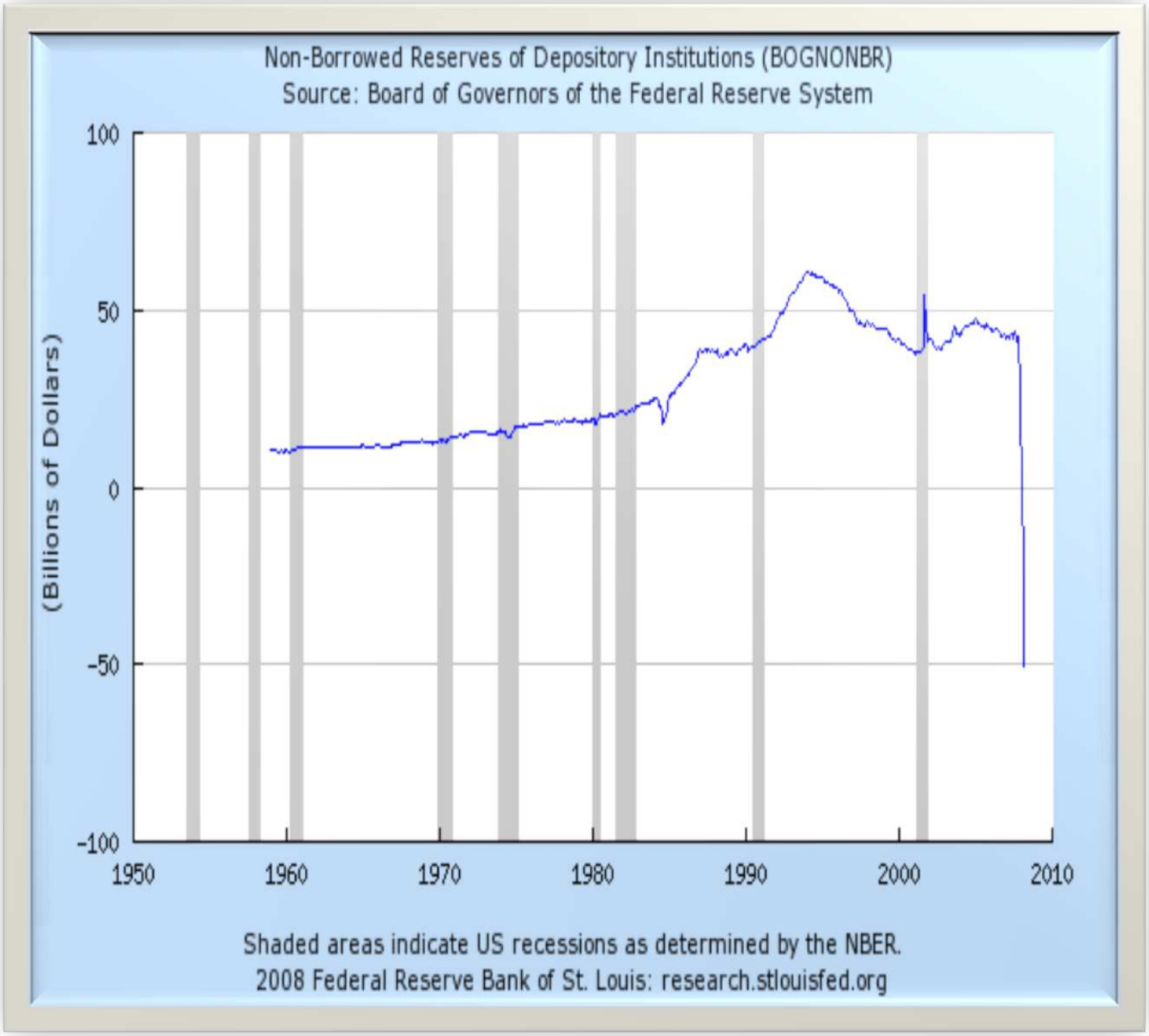


*Figure 22*: Nonborrowed Reserves




## 10. Conclusion

We have shown that most of the puzzles and paradoxes that have evolved in the monetary economics literature were produced by the disreputable simple-sum monetary aggregates provided officially by most central banks and are resolved by use of aggregation-theoretic monetary aggregates. We argue that official central-bank data throughout the world has not significantly improved, despite the existence of better data internal to some of those central banks for their own use. As a result, researchers should be very cautious about the use of official central-bank data in research. We document the fact that the profession has repeatedly been misled by bad central-bank monetary data over the past half century.

Many commonly held views need to be rethought, since many such views were based upon atheoretical data. Most conspicuously, the views on the Great Moderation need to be reconsidered. We find no reason to believe that the moderation in the business cycle during the past two decades had an appreciable connection with improved monetary policy, and in fact we find no reason to believe that there have been significant improvements in monetary policy over that time period. In particular, we believe that the increased risk-taking that produced the recent financial crisis resulted from a misperception of cyclical systemic risk. We are not comfortable with the widespread view that the source of the crisis is the "greed" of the victims of the misperceptions. In fact, the research that we survey in this paper has been warning of those misperceptions throughout the more than two decades of the Great Moderation. The recent economic consequences are easily understood in that context.

# Appendix

*Figure A1*: Milton Friedman, *Newsweek*, Sept 26, 1983

MILTON FRIEDMAN

## A Case of Bad Good News

President Reagan, politicians of all political persuasions, journalists specializing in economics, Wall Street, the business community—all these and many more are hailing the recent economic statistics showing rapid growth in output and employment as very good news indeed.

One group of economists—the monetarists—are a conspicuous exception. We were also an exception to what I labeled in February as "misleading unanimity" among economic forecasters (NEWSWEEK, Feb. 7, 1983). Almost to a person economic forecasters were predicting a slow and sluggish recovery. We predicted that "1983 will be a year of rapid and vigorous economic growth."

**Monetary Explosion:** That judgment was based on two considerations: the length and severity of the recession that ended in December 1982, and the monetary explosion that was then in process—a rise in $M_1$ at the annual rate of 15 percent from July 1982 to January 1983. It seemed to us that "this monetary explosion assures vigorous economic growth in the coming months"—but also that "unfortunately, if it continues much longer, it will also produce a renewed acceleration of inflation and a sharp rise in interest rates." The monetary explosion did produce vigorous growth. Unfortunately, it also did continue—at the annual rate of more than 14 percent from January to July. Interest rates have already risen sharply. Inflation has not yet accelerated. That will come next year, since it generally takes about two years for monetary acceleration to work its way through to inflation.

The "good news," that output grew at the annual rate of nearly 9 percent in the second quarter of this year and may equal that record in the third quarter, is really bad news—the sign of an overheated economy headed for trouble. We do not need another sharp but brief expansion—like 1980 to 1981—followed by a relapse into recession. We need moderate growth at a rate that can be maintained for a long time along with continued reduction in inflation.

The only way to maintain anything like the recent hectic pace of real growth would be to keep the monetary explosion going. But even if the Fed has learned nothing from experience, the market has—as its recent reactions to money-growth figures demonstrate. If the monetary explosion continued, both interest rates and inflation would react much more promptly than in the past. Both would head toward the sky. That reaction would make it nearly impossible for the Fed to continue the monetary explosion. However reluctantly, it will have to step on the brakes—as it already has apparently started to do.

> The monetary explosion leaves no satisfactory way out of our present situation.

The monetary explosion from July 1982 to July 1983 leaves no satisfactory way out of our present situation. The Fed's stepping on the brakes will appear to have no immediate effect. Rapid recovery will continue under the impetus of earlier monetary growth. With its historical shortsightedness, the Fed will be tempted to step still harder on the brake—just as the failure of rapid monetary growth in late 1982 to generate immediate recovery led it to keep its collective foot on the accelerator much too long. The result is bound to be renewed stagflation—recession accompanied by rising inflation and high interest rates.

**Recession and the Election:** The only real uncertainty is when the recession will begin. That will depend partly on the pattern of monetary growth over coming months, partly on other developments that cannot now be foreseen. Monetarists have always emphasized that the time delay between monetary change and economic change is not only long but also highly variable. Indeed, that is why we are so skeptical about the kind of monetary "fine-tuning" that the Fed has engaged in and why we favor steady monetary growth.

The precise timing of the recession will largely determine the political climate of election year 1984. Both President Reagan's supporters and his opponents are acting as if they expect recent favorable economic developments to continue through 1984—as evidenced by the search on the part of both for other issues to stress. They will be right if the recession does not begin before the third quarter of 1984. But if the recession should begin in the first or second quarter of 1984—as is entirely possible—the situation will be very different. In that case the election campaign would be conducted in an environment of declining output, rising unemployment, rising inflation and high interest rates—hardly an environment favorable to an incumbent.

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NEWSWEEK/SEPTEMBER 26, 1983

*Figure A2*: William Barnett, *Forbes*, Sept 26, 1983

# Faces
## Behind The Figures

Edited by John R. Dorfman

### What explosion?

If you were measuring the nation's vehicle supply, you wouldn't give equal weight to roller skates and locomotives. But that, in effect, is what the Federal Reserve Board does in measuring the money supply, says William Barnett, an economist at the University of Texas (Austin).

The Fed has realized, Barnett says, that M1 excludes too many forms of money, such as the new money market accounts at banks. But the higher aggregates like M2 and M3, he says, suffer greatly from the "skates and locomotives" problem. Some of their components are much more liquid than others.

How can the Fed control money if it can't adequately define it? You have heard the question before. Barnett thinks he has the answer: Divisia aggregates, named after the late French statistician François Divisia, who published a famous paper on the subject in 1925. In Barnett's Divisia formula, the changes in the supply of various forms of money are weighted according to how liquid each form is. Checking accounts, for example, get more weight than certificates of deposit. To get his weighting factors, Barnett looks at the opportunity cost of holding such low-yield assets as checking accounts and passbook savings accounts. When you give up yield, his model figures, you are probably getting liquidity in exchange.

Crunching Divisia numbers leads Barnett to two conclusions. One is that the Fed was much tighter than it intended to be during the period from late 1979 through mid-1982. For example, in 1982, M2, measured the usual way, was up 9.4%. But Divisia M2 was up only 7.8%.

The other conclusion is that people have been panicking unnecessarily about money supply growth this year. The new bank money funds and the super NOW accounts have been sucking in money that was formerly held in other forms, and other types of asset shuffling also have occurred. But the Divisia aggregates are rising at a rate not much different from last year's, Barnett says. Thus, the "apparent explosion" can be viewed as a statistical blip.

*Economist William Barnett*

***A new set of "M" numbers?***

Is anybody listening? Yes, says Barnett, who was a research economist for the Fed for eight years until 1981. Some Fed members, including Governor Henry Wallich, regularly peruse his numbers. Such economists as Paul Samuelson, James Tobin and Milton Friedman also receive the Divisia numbers monthly. It's only a matter of time, he figures, before the Fed will go to Divisia aggregates as its official guide. "They've run out of other alternatives," says Barnett, "and are looking at this very seriously."—J.R.D.

### States' rights?

As the sovereign state of South Carolina sees it, there is a provision written into the Tax Equity & Fiscal Responsibility Act (TEFRA) of 1982 that amounts to an unconstitutional effort by Washington to abrogate what remains of state powers. TEFRA mandates that bonds sold by states after July 1, 1983 be issued in registered (not bearer) form. If a state breaks this rule, the interest on the bonds can be taxed by the IRS.

That requirement galls Grady L. Patterson Jr., 59, South Carolina's

*South Carolina Treasurer Grady L. Patterson Jr*

***Can one level of government tax another?***

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