REVIEW

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Recent Developments in the Analysis of Monetary Policy Rules

Bennett T. McCallum

It is a great privilege for me to be giving this year's Homer Jones Memorial Lecture, in recognition of Homer Jones's outstanding role in the development of monetary policy analysis. I did not know him personally, but I have been very strongly influenced by economists who knew and admired him greatly—Karl Brunner, Milton Friedman, and Allan Meltzer come to mind immediately. My work has also been influenced by writings coming from the research department of the Federal Reserve Bank of St. Louis, which he directed, and by the availability of monetary data series developed there.

For this lecture I originally had planned a title of "The Evolution of Monetary Policy Analysis, 1973-1998." As it happens, I have decided to place more emphasis on today's situation and less on its evolution. But, a few words about history may be appropriate. I had chosen 1973 as the starting point for a review because there was a sharp break in both academic analysis and in real-world monetary institutions during the period around 1971-73. Regarding institutions, of course, I am referring to the breakdown of the Bretton Woods exchange-rate system, which was catalyzed by the U.S. government's decision in August 1971 not to supply gold to other nations' central banks at $35 per ounce. This abandonment of the system's nominal anchor naturally led other nations to be unwilling to continue to peg their currency values to the (overvalued) U.S. dollar, so the par-value arrangements disintegrated. New par values were painfully established during the December 1971 meeting at the Smithsonian Institution, but after a new crisis, the system crumbled in March 1973.

In terms of monetary analysis, the starting date of 1973 has the disadvantage of missing the publication in 1968 and 1970 of the Andersen-Jordan (1968) and Andersen-Carlson (1970) studies, which many of you will know were written at the St. Louis Fed under the directorship of Homer Jones. These studies were, to an extent, a follow-up to the Friedman-Meiselman (1963) paper, which had set off a period of intellectual warfare between economists of a then-standard Keynesian persuasion and those who were shortly (Brunner, 1968) to be termed "monetarists."[1] But my reason for beginning slightly later is that the years 1971-73 featured the publication of six papers that initiated the rational expectations revolution. The most celebrated of these is Lucas's (1972a) "Expectations and the Neutrality of Money," but his other papers (1972b) and (1973) also were extremely influential as were Sargent's (1971 and 1973). The sixth paper is Walters (1971), which had little influence but was, I believe, the first publication to use rational expectations (RE) in a macro-monetary analysis.

At first there was much resistance to the RE hypothesis, partly because it initially was associated with the policy-ineffectiveness proposition. But, it gradually swept the field in both macro and microeconomics, primarily because it seems extremely imprudent for policy analysis to be conducted under the assumption that any particular pattern of expectational errors will prevail in the future—and ruling out all such patterns implies RE.

There were other misconceptions regarding rational expectations, the most prominent of which was that Lucas's famous "critique" paper (1976) demonstrated that policy analysis with econometric models

[1] Initially, I was not an admirer of the Andersen-Jordan study, but later my evaluation jumped up considerably, as can be seen from McCallum (1986). Right from the start, however, I was one of the many analysts who were stimulated into active research in the area by that paper's bold and innovative use of statistical tools to examine basic issues relating to monetary policy.

Table 1

Conference Contributors

	NBER Conference Jan. 17-18, 1998		
	Papers	Discussants	
Academic	5.5	8	
Central Bank	3.5	1	
Total	9	9	
	Riksbank-IIES Conference, June 12-13, 1998		
	Papers	Discussants	Panelists
Academic	5	1	2
Central Bank	2	6	3
Total	7	7	5

was a fundamentally flawed undertaking. Actually, of course, Lucas and Sargent showed instead that certain techniques were flawed, if expectations are indeed rational, and that more sophisticated techniques are called for. But by 1979, John Taylor, last year's Homer Jones lecturer, had demonstrated that these techniques are entirely feasible. Nevertheless, this misunderstanding—and others concerning the role of money[2]—led to a long period during which there was a great falling off in the volume of sophisticated, yet practical, monetary policy analysis. One reason was the upsurge of the real-business-cycle (RBC) approach to macroeconomic analysis, which in its standard version assumes that price adjustments take place so quickly that, for practical purposes, there is continuous market clearing for all commodities, including labor. In this case, monetary policy actions will, in most models, have little or no effect on real macroeconomic variables at cyclical frequencies. Of course this has been a highly controversial hypothesis and I am on record as finding it quite dubious (McCallum, 1989). But my attitude is not altogether negative about RBC analysis because much of it has been devoted to the development of new theoretical and empirical tools, ones that can be employed without any necessary acceptance of the RBC hypothesis about the source of cyclical fluctuations.

In recent years, in fact, these tools have been applied in a highly promising fashion. Thus a major movement has been underway to construct, estimate, and simulate monetary models in which the economic actors are depicted as solving dynamic optimization problems and then interacting on competitive markets,[3] as in the RBC literature, but with some form of nominal price and/or wage "stickiness" built into the structure. The match between these models and actual data is then investigated, often by standard RBC procedures, for both real and monetary variables and their interactions. The objective of this line of work is to combine the theoretical discipline of RBC analysis with the greater empirical validity made possible by the assumption that prices do not adjust instantaneously. Basically, the attempt is to develop a model that is truly structural, immune to the Lucas critique, and appropriate for policy analysis.

As a consequence of this movement, and some other activities to be mentioned shortly, the state of monetary policy analysis today (March 1999) is remarkably different than it was only a few years ago. Most of the changes are clearly welcome improvements, although some are of more debatable merit. Let me now describe central aspects of the current situation before turning to an evaluation and an application.

One striking feature of research on monetary policy today is the extent of interaction between central-bank and academic economists and the resulting similarity of the research conducted. This feature is illustrated nicely by the contributions to two recent conferences entitled "Monetary Policy Rules." The first of these was sponsored by the National Bureau of Economic Research (NBER), held January 17-18, 1998, in Islamorada, Florida. The second, held June 12-13, 1998, in Stockholm, was jointly sponsored by the Sveriges Riksbank (the Swedish central bank) and the Institute for International Economic Studies at Stockholm University.

2 Here I have in mind the promotion of a class of overlapping-generations models in which the asset termed money plays no medium-of-exchange role.

3 Actually, writings in this literature typically express their analysis as pertaining to economies featuring monopolistic competition. In typical cases, most of the results are independent of the extent of monopoly power, which then could be virtually zero.

In Table 1, the figures on contributors clearly indicate that both academic and central-bank participation was substantial, but they do not begin to tell the whole story. They do not show, for example, that four of the papers were authored jointly by one economist from each group. Nor do they reveal that two of the designated academics were central bankers until very recently; that three others had (like the St. Louis Fed's William Poole and Robert Rasche) moved in the opposite direction; or that currently one is both a leading professor and a member of the Bank of England's Monetary Policy Board. The fact that several academic participants are regular central-bank consultants is also not shown.

But to get the full flavor of the extent to which central-bank and academic monetary analysis has done away with distinctions that were important only recently, one needs to read the papers. It is my impression that if the authors' names were removed, one would find it extremely difficult to tell which group the author or authors came from. To me, this intense interaction seems to represent a very positive change, and is one toward which several regional Federal Reserve Banks (including St. Louis) have contributed greatly.

In the research presented at these two conferences there was not just a similarity of technique across groups, but also a considerable amount of agreement across authors about the outline of an appropriate framework for the analysis of monetary policy issues. Such agreement can be dangerous, of course, but it certainly facilitates communication. In fact, there remains room for quite a bit of substantive disagreement within the framework, so on balance I find this similarity somewhat encouraging. In any event, I would like to describe this framework and then take up some major issues that I hope you will find interesting.

The nearly standard framework at the NBER and Riksbank conferences is a quantitative macroeconomic model that includes three main components. These are:

- An IS-type relation (or set of relations) that specifies how interest-rate movements affect aggregate demand and output;
- A price adjustment equation (or set of equations) that specifies how inflation behaves in response to the output gap and to expectations regarding future inflation; and
- A monetary policy rule that specifies each period's settings of an interest-rate instrument.

These settings typically are made in response to recent or predicted values of the economy's inflation rate and its output gap. A leading example of such a rule will be considered at length shortly. Most of these are quarterly models and most incorporate rational expectations. They are estimated by various methods, including the approach called "calibration," but in all cases an attempt is made to produce a quantitative model in which parameter values are consistent with actual time-series data for the United States or some other economy. These models are intended to be structural (i.e., policy invariant) and in some cases this attempt is enhanced by a modeling strategy that features explicit optimization by individual agents acting in a dynamic and stochastic environment.

To study effects of policy behavior, stochastic simulations are conducted using the model at hand with alternative policy rules, with summary statistics being calculated to represent performance measured by average values of the variability of inflation, the output gap, and interest rates. A few of the models are constructed so that each simulation implies a utility level for the representative individual agent; in such cases, utility-based performance measures can be calculated. In several studies, effort is taken to make the policy rules *operational*, which, with an interest instrument, means a realistic specification of information available to the central bank when setting its instrument.

In discussing in more detail the components of this framework, it will be useful to have an algebraic representation of a simple special case. Here I will use y_t to denote the natural logarithm of real gross domestic product (GDP) during quarter t, with $\bar{y}_t$ being the capacity or potential or natural rate value of y_t. Then $\tilde{y}_t = y_t - \bar{y}_t$ is the output gap. Also p_t is the log of the price level so Δp_t is the inflation rate while g_t represents real government purchases and R_t is the level of the short-term nominal interest rate used as the central bank's instrument.

$$(1)\quad y_t = \beta_0 + \beta_1 E_t y_{t+1} + \beta_2(R_t - E_t\Delta p_{t+1}) + \beta_3(g_t - E_t g_{t+1}) + v_t$$

$$(2)\quad \Delta p_t = \alpha_1 E_t \Delta p_{t+1} + (1-\alpha_1)\Delta p_{t-1} + \alpha_2(y_t - \bar{y}_t) + u_t$$

$$(3)\quad R_t = \bar{r} + E_t\Delta p_{t+j} + \mu_1(E_t\Delta p_{t+j} - \pi^*) + \mu_2(y_t - \bar{y}_t) + e_t$$

Here $E_t z_{t+j}$ is the rationally formed expectation at time t of the value of z that will prevail in period $t+j$, so $E_t\Delta p_{t+1}$ is the expected inflation rate and $R_t - E_t\Delta p_{t+1}$ is the one-period real rate of interest. The terms v_t, u_t, and e_t represent random disturbance factors that impinge on the choices of individuals and the central bank; these are not observable to an econometrician. The parameters designated β, α, and μ do not change with time, unlike the variables that carry the subscript t. All parameters except β_2 are presumed to be positive.

Relation 1 is a so-called IS function in which β_2 is a negative number, reflecting the hypothesis that the real rate of interest has a negative effect on demand; higher real interest rates tend to depress spending by households and firms. If $\beta_1 = 0$, then the IS function would be one of the textbook Keynesian variety that is somewhat lacking in theoretical justification. With $\beta_1 = 1$, however, we have a forward-looking "expectational" or "intertemporal" IS relation of the type several authors have shown to be implied, under reasonable conditions, by optimizing dynamic behavior.[4] With this latter type of relationship, the proper appearance of government purchases is as shown in equation 1. This is of some interest, for it implies that if changes in g_t are approximately permanent, then an upward jump in g_t will be offset by an upward jump in $E_t g_{t+1}$, leaving demand unaffected. That type of phenomenon may be the reason that many investigators have obtained econometric results suggesting that government purchases have insignificant explanatory power for aggregate demand.

The price-adjustment equation 2 is written so as to accommodate either the entirely forward-looking Calvo-Rotemberg model,[5] in which case $\alpha_1 = 1$, or a two-period version of the Fuhrer and Moore (1995) model (with $\alpha_1 = 0.5$). Neither of these, I would point out, satisfies the strict version of the natural rate hypothesis (NRH) due to Lucas (1972b), which postulates that monetary policy cannot keep $y_t > \bar{y}_t$ permanently by *any* sustained scheme of behavior. (More precisely, the NRH implies that $E(y_t - \bar{y}_t) = 0$ for any policy rule.[6]) I personally consider this violation to be a weakness, an indication that specification 2 is faulty.[7] But both the Calvo-Rotemberg and Fuhrer-Moore models are more attractive (and plausible) in that regard than the NAIRU class,[8] which gets more attention from the press and practical commentators, for the latter class implies that an increasing inflation rate will keep output high forever (in contrast to either of the mentioned versions of 2). That the press—and even some professional publications[9]—fails to distinguish between the NRH and the NAIRU concept is, in my opinion, slightly disgraceful, especially since the very term NAIRU suggests an incompatibility with the NRH.[10]

The third component of this simple system is the monetary policy rule that is shown in equation 3. It suggests that with μ_1 and μ_2 positive the central bank will raise R_t, thereby tightening policy, when inflation exceeds its target value π^* and/or when output is high relative to capacity. Thus equation 3 has been written in approximately the form suggested by Taylor (1993), which has come to be known as "the Taylor rule." I will have quite a bit to say about that rule below, but for the moment I wish to take up the point that the system (equations 1-3) does not include a money demand-function. Indeed, it does not refer to any monetary quantity measure in any way whatsoever. To anyone steeped in the tradition of Homer Jones, this strikes a rather dissonant note. So let's take a minute to consider whether this is sensible.

4 These authors include Kerr and King (1996), McCallum and Nelson (1999), and Woodford (1995).

5 The references are Calvo (1983) and Rotemberg (1982).

6 It can be verified easily that equation 2 implies that if policy generates inflation such that $E(\Delta p_t - \Delta p_{t-1}) \neq 0$, then $E(y_t - \bar{y}_t) \neq 0$.

7 One of the few relations with price stickiness that satisfies the NRH is my own favorite, the P-bar model used by McCallum and Nelson (1999). Its weakness is that it does not yield as much persistence in inflation as appears in the data.

8 Typified by $\Delta p_t = \alpha_1\Delta p_{t-1} + (1-\alpha_1)\Delta p_{t-2} + \alpha_2(y_t - \bar{y}_t) + u_t$.

9 See, e.g., the symposium in the winter 1997 issue of the *Journal of Economic Perspectives*.

10 The term "non-accelerating-inflation rate of unemployment" suggests a relationship between $\Delta p_t - \Delta p_{t-1}$ and $y_t - \bar{y}_t$ in immediate contradiction to the NRH.

To do that, suppose that we add to the system a standard money demand function. Let m_t be the log of the money stock, either the monetary base or M1 depending on whether or not a banking sector behavior is included. Then we have

$$(4) \qquad m_t - p_t = \gamma_0 + \gamma_1 y_t + \gamma_2 R_t + \varepsilon_t$$

where ε_t is the random component of money demand. Here y_t is a proxy measure of the transactions that money facilitates and R_t is an (overly simple) measure of the opportunity cost of holding money rather than some other asset. In an actual application, some account might have to be taken of technical progress in the payments process, but for present purposes that complication is unnecessary. The first basic point to be made is that if we append equation 4 to the system (equations 1-3), it plays no essential role. It merely determines how much money has to be supplied by the central bank in order to implement its interest rate policy rule, equation 3. The system (equations 1-3) determines the same values for Δp_t, y_t, and R_t whether equation 4 is recognized or not, presuming that $\bar{y}_t$ and g_t are exogenously given. This is the basic point that has led many researchers to ignore money and, indeed, that has led the staff of the Fed's Board of Governors to construct a large, sophisticated, and expensive new macroeconometric model that does not recognize money in any capacity.[11] But is the point *valid*?

Evidently, there are at least two requirements for it to be valid. First, the central bank of the economy being modeled actually conducts policy by manipulating a real-world counterpart of R_t, while paying no decisive attention to current movements in m_t. It is widely agreed that this is the case for the United States and most other industrialized nations, including Germany.[12] Second, it must be the case that m_t does not appear in correctly specified versions of either equations 1 or 2. With respect to the latter, that condition would seem to be satisfied; but for the expectational IS function 1 it is more problematical. What is required in a mainstream theoretical analysis[13] is that the transaction-cost function, which describes the way that money (the medium of exchange) facilitates transactions, must be *separable* in m_t and the spending variable such as y_t. But there is no theoretical reason for that to be the case and it clearly is *not* the case for my own preferred specification. So what is actually being assumed implicitly, by analyses that exclude m_t (i.e., $m_t - p_t$) from the relation 1, is that the effects of money holdings on spending are quantitatively small (indeed negligible). This is a belief with a long tradition, and I am inclined to think that it is probably justifiable, but the whole matter needs additional study.

One of the fortuitous events that led to today's era of cooperation between central-bank and academic economists was the publication of a 1993 paper by John Taylor—the one in which he explicitly proposed the now famous Taylor rule. By writing his rule in terms of the instrument actually used by central banks and expressing his formula with brilliant simplicity, Taylor made the concept of a monetary rule more palatable to central bankers—especially as he showed that recent U.S. experience had in fact conformed to his formula rather closely.[14] Simultaneously, the step was attractive to academics because it enabled them both to simplify their analysis, by discarding money demand functions, and also to be more realistic.

The precise rule proposed by Taylor (1993) for the U.S. economy is as follows:

$$(5) \quad R_t = \Delta p_t^a + 0.5\,(\Delta p_t^a - \pi^*) + 0.5\ \tilde{y}_t + \bar{r}.$$

Here Δp_t^a is the average inflation rate over the past four quarters—a proxy for expected inflation—and $\tilde{y}_t$ is $y_t - \bar{y}_t$, the output gap. For $\bar{r}$, the average *real* rate of interest, Taylor assumed 2 percent (per year) and for the inflation target π^* he also assumed 2 percent. So he actually wrote the expression, with p denoting inflation, y denoting $\tilde{y}$, and r instead of R, as follows: $r = p + 0.5y + 0.5(p - 2) + 2$. In thinking about this rule, it is important to recognize that it does not involve the fallacy of using a nominal interest rate as an indicator of monetary tightness or ease.

11 See Brayton, et. al. (1997).

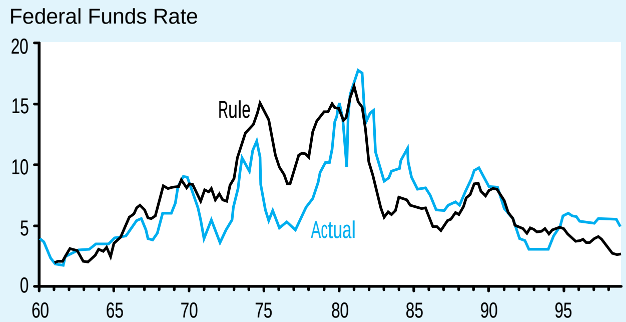
12 On this point, see Clarida and Gertler (1996).

13 Such as that of Walsh (1998) or McCallum and Goodfriend (1987).

14 It also helped, I am sure, that he emphasized that rule-like behavior does not require literal, strict adherence to a specified formula.

Figure 1

Taylor Rule and Actual Values for U.S., 1961-98



Rather, it compares the real rate $R_t - \Delta p_t^a$ with its long-run equilibrium value $\bar{r}$ and adjusts the former upward if the current situation, represented by $0.5\ (\Delta p_t^a - \pi^*) + 0.5\ \tilde{y}_t$, calls for a tighter stance.

To illustrate the workings of the Taylor rule we can look at a diagram, similar to one recently constructed by Taylor (1999), that compares actual historical values of the U.S. federal funds rate with values that would have been dictated by the rule during the years 1960-98. In Figure 1 we see that the two curves agree very closely during the years 1987-94, but disagree sharply for the period from 1965-78, with the Taylor rule calling for much tighter policy through most of that period. Both of these comparisons are quite encouraging for the Taylor rule, for most analysts would now agree that U.S. policy was quite good during 1987-94 and considerably too loose during 1965-78.

If you find the Taylor rule interesting, you can always keep up to date on its advice by going to the web site of the St. Louis Fed. In the publication entitled *Monetary Trends*, the bank plots a different but related diagram that shows what the implicit inflation target of the Fed has been recently, according to the Taylor rule, and recent values of the federal funds rate. The diagram available in February 1999 shows that as of mid-1998 the implicit target was about 1 percent inflation. Thus, the Taylor rule indicates that the recent U.S. monetary stance has been slightly more restrictive than one that would yield 2 percent inflation, the value that most analysts consider to best represent the Fed's actual (although unstated) inflation target.

On the same page of *Monetary Trends* there is another chart that pertains to a different rule, one that I am happy to say is known as the McCallum rule. It is entirely appropriate that my rule appears after Taylor's, because his is much more popular with both central bankers and academics. A major reason is that mine is expressed in terms of settings for the growth rate of the adjusted monetary base—currency plus bank reserves—rather than any interest rate. Therefore, Taylor's is much more realistic in the sense of pertaining to the central bank's actual instrument variable. In fact, many central bankers view discussions of the monetary base with about the same enthusiasm as I would have for the prospect of being locked in a telephone booth with someone who had a bad cold, or some other infectious disease.

That does not necessarily mean, however, that a base-oriented rule will give poorer advice concerning monetary policy. Historically, my rule—which adjusts the base growth rate up or down when nominal GDP growth is below or above a chosen target value[15]—has agreed with Taylor's over many periods. But, they differed in the United Kingdom during the late 1980s when mine would have called for tighter policy and Taylor's for looser. Since that was a period during which U.K. inflation rose rather rapidly—after having been temporarily subdued by the onslaught of Margaret Thatcher—this episode is one that can be pointed out, when I want to argue the merits of my rule.

I also must say that it would be very wrong to interpret this contrast of rules as representing a dispute between Taylor and me. I believe that the two of us are striving for basically the same policy goals: a stable, rule-like monetary policy designed to keep inflation low and to do what little it can to stabilize real output fluctuations. Furthermore, I am confident that he shares this belief. And I certainly have no hesitation in saying that he has been the more effective spokesman for our cause.

[15]The target value Δx^* equals the desired average rate of inflation plus the expected long-run average rate of growth of real output—say, $2.0 + 2.5 = 4.5$ percent per year (or 0.01125 in quarterly fractional units). Then the rule is $\Delta b_t = \Delta x^* - \Delta v^a_t + 0.5(x^*_{t-1} - x_{t-1})$ where b_t and x_t are logs of the base and nominal GDP while Δv^a_t is the average rate of growth of base velocity over the previous four years. Also, x^*_t is the target value of x_t for period t, equal to $x_{t-1} + \Delta x^*$.

That said, in closing I would like to apply our two rules to the extremely important case of Japan during the 1990s. To do this with the Taylor rule requires us to adopt values for π^* and $\bar{r}$, the inflation target and the long-run average real interest rate. For the former, I again will take 2 percent in measured terms (which probably overstates the actual inflation rate in Japan by about 1 percent). For $\bar{r}$, Taylor's (1993) procedure was to use a number close to the long-run average rate of output growth. At present, this is hard to judge in Japan but I will use 3 percent since output grew at a rate of 4 percent over 1972-92. Estimating the output gap is even more difficult, but here my procedure is to fit a trend line for $\bar{y}_t$ over 1972:1-1992:4, and then to assume a growth rate of $\bar{y}_t$ equal to 2.5 percent since 1992:2.[16]

The results of this exercise are shown in Figure 2. That policy needed to be much tighter over 1972-78 shows up clearly, and that policy was on track or somewhat too tight over 1982-87 is suggested. But our main interest resides in more recent policy. Figure 2 indicates that it was about right over 1988-93, but, except for 1997, has been too tight since 1994. At the end of 1998, the call rate was slightly over 3 percent too high, the rule-indicated value being –3.0 percent. Of course this latter value is not feasible, but it indicates that the rule calls for much more stimulative policy than what actually prevailed in late 1998.[17]

Now let us see what the McCallum rule has to say. For this exercise I adopt the same value of π^* and use 3 percent as the long-run average growth rate of real output, yielding a nominal GDP growth target of 5 percent per year or $\Delta x^* = 0.0125$ in quarterly log units. The results of this exercise are shown in Figure 3, with the base growth rates expressed in per-annum percentage points. Here, when the solid rule-suggested values are greater than the dotted actual values for base growth, the indication is that policy should have been looser. Thus, we see that this rule agrees with Taylor's regarding 1972-78 and 1994-98. It suggests that policy was too loose on average over 1986-89 (when U.S. policymakers were encouraging a weaker yen).

Figure 2

Taylor Rule and Actual Values for Japan, 1972-98

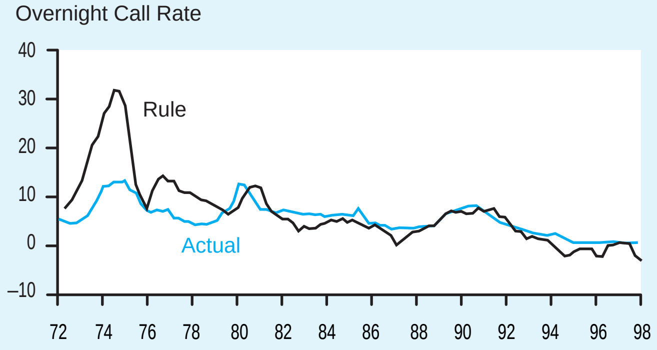
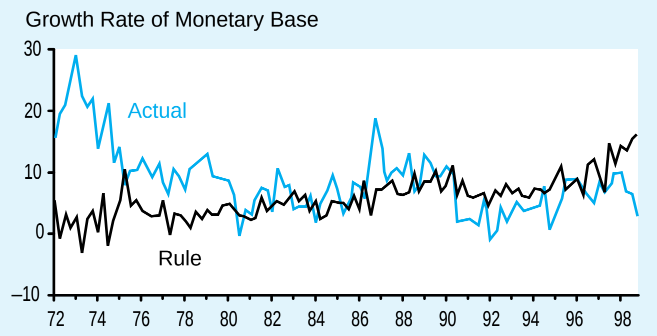


Figure 3

McCallum Rule and Actual Values for Japan, 1972-98



And regarding the more recent period, Figure 3 agrees that policy has been too tight during 1994-98 but suggests that this period of monetary stringency began several years earlier—around the middle of 1990.

I believe that most academic analysts quite recently have come to share the viewpoint indicated in this last picture, i.e., that Japanese monetary policy has been too tight since the early 1990s. It is extremely unfortunate for Japan and perhaps for the world that this view did not prevail sooner. In fact, it did prevail among economists of a monetarist or semi-monetarist persuasion. My own small contributions are mentioned in footnote 19. More prominently, the written contributions of Goodfriend (1997) and

[16] This is in my opinion a weakness of the Taylor rule; knowledge of the level of $\bar{y}_t$ is not needed for mine.

[17] Most commentators simply assert that negative nominal interest rates are impossible. I believe that statement is too strong, partly for reasons indicated by Thornton (1999). But rates well below zero do seem implausible.

Taylor (1997) called for greater monetary stimulus by Japan, including, if necessary, purchases of foreign exchange or non-traditional assets.[18] Milton Friedman's *Wall Street Journal* article of December 1997 put forth a similar position quite strongly, as did Allan Meltzer's piece in the *Financial Times* (1998).

During the years 1995-98, however, it was orthodox opinion in the financial press—including the *Financial Times* and *The Economist*—that monetary policy could provide no more stimulus in Japan "because interest rates were already as low as they could go." This view was not challenged by most academics. Figure 3, however, indicates that a policy rule that uses the monetary base as an essential variable would have been giving signals indicative of overly tight policy for years, if anyone had bothered to look.[19] The Taylor rule concurs, but it did not begin to give these signals until later—and also does not agree regarding the period 1986-89. My conclusion is that one does not have to be an opponent of the Taylor rule or the analytical framework shown in equations 1-3—which I am not—to believe that there remains an extremely important role to be played by measures of the monetary base and other monetary aggregates. I would like to believe that Homer Jones would have approved of this conclusion.

[18] These contributions were delivered at the Seventh International Conference of the Bank of Japan, held in Tokyo in October 1995.

[19] In fact I did look, although in a less effective way, in McCallum (1993) and McCallum and Hargraves (1995). The story was similar to that as shown in Figure 3.

REFERENCES

Andersen, Leonall C., and Jerry L. Jordan. "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," this *Review* (November 1968), pp. 11-24.

Andersen, Leonall C., and Keith M. Carlson. "A Monetarist Model for Economic Stabilization," this *Review* (April 1970), pp. 7-25.

Brayton, Flint, Andrew Levin, Ralph Tryon, and John C. Williams. "The Evolution of Macro Models at the Federal Reserve Board," *Carnegie-Rochester Conference Series on Public Policy* (December 1997), pp. 43-81.

Brunner, Karl. "The Role of Money and Monetary Policy," this *Review* (July 1968), pp. 9-24.

Calvo, Guillermo A. "Staggered Prices in a Utility Maximizing Framework," *Journal of Monetary Economics* (September 1983), pp. 383-98.

Clarida, Richard, and Mark Gertler, "How the Bundesbank Conducts Monetary Policy," in *Reducing Inflation: Motivation and Strategy*, Christina D. Romer and David H. Romer, eds. University of Chicago Press, 1996, pp. 363-406.

Friedman, Milton, and David Meiselman. "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958," in *The Commission on Money and Credit*, *Stabilization Policies*, Prentice Hall, 1963, pp. 165-268.

Friedman, Milton. "Rx for Japan: Back to the Future," *Wall Street Journal* (Dec. 17, 1997), p. 22.

Fuhrer, Jeffrey C., and George R. Moore. "Inflation Persistence," *Quarterly Journal of Economics* (February 1995), pp. 127-59.

Goodfriend, Marvin. "Comments," in *Towards More Effective Monetary Policy*, Iwao Kuroda, ed., St. Martin's Press, 1997, pp. 289-95.

Kerr, William, and Robert G. King. "Limits on Interest Rate Rules in the IS Model," Federal Reserve Bank of Richmond *Economic Quarterly* (Spring 1996), pp. 47-75.

Lucas, Robert E., Jr. "Expectations and the Neutrality of Money," *Journal of Economic Theory* (April 1972a), pp. 103-24.

_________. "Econometric Testing of the Natural-Rate Hypothesis," *The Econometrics of Price Determination*, Otto Eckstein, ed., Board of Governors of the Federal Reserve System, 1972b, pp. 50-9.

_________. "Some International Evidence on Output-Inflation Tradeoffs," *American Economic Review* (June 1973), pp. 326-34.

_________. "Econometric Policy Evaluation: A Critique," *Carnegie-Rochester Conference Series on Public Policy* (1976), pp. 19-46.

McCallum, Bennett T. "Monetary versus Fiscal Policy Effects: A Review of the Debate," in *The Monetary Versus Fiscal Policy Debate: Lessons from Two Decades*, Hafer, R.W., ed., Rowman and Allanheld, 1986, pp. 9-29.

_________. "Real Business Cycle Models," in *Modern Business Cycle Theory*, Robert J. Barro, ed., Harvard University Press, 1989, pp. 16-50.

_________. "Specification and Analysis of a Monetary Policy Rule for Japan," Bank of Japan, *Monetary and Economic Studies* (November 1993), pp. 1-45.

_________ and Marvin Goodfriend. "Demand for Money: Theoretical Studies," in *The New Palgrave: A Dictionary of Economics.* John Eatwell, Murray Milgate, and Peter Newman, eds., Stockton Press, 1987.

_________ and Monica Hargraves. "A Monetary Impulse Measure for Medium-Term Policy Analysis," *Staff Studies for the World Economic Outlook*, (September 1995), International Monetary Fund, pp. 52-69.

_________ and Edward Nelson. "An Optimizing IS-LM Specification for Monetary Policy and Business Cycle Analysis," *Journal of Money, Credit, and Banking* (August 1999a), pp. 296-316.

_________ and _________. "Performance of Operational Policy Rules in an Estimated Semi-Classical Structural Model," in *Monetary Policy Rules*, John B. Taylor, ed., University of Chicago Press, 1999b, pp. 15-45.

_________ and _________. "Nominal Income Targeting in an Open-Economy Optimizing Model," *Journal of Monetary Economics* (June 1999c), pp. 553-78.

Meltzer, Allan H. "Time to Print Money," *Financial Times* (July 17, 1998), p. 14.

Rotemberg, Julio J. "Monopolistic Price Adjustment and Aggregate Output," *Review of Economic Studies* (October 1982), pp. 517-31.

Sargent, Thomas J. "A Note on the Accelerationist Controversy," *Journal of Money, Credit, and Banking* (August 1971), pp. 721-25.

__________. "Rational Expectations, the Real Rate of Interest, and the Natural Rate of Unemployment," *Brookings Papers on Economic Activity* (No. 2, 1973), pp. 429-72.

Taylor, John B. "Estimation and Control of a Macroeconomic Model with Rational Expectations," *Econometrica* (September 1979), pp. 1267-86.

__________. "Discretion versus Policy Rules in Practice," *Carnegie-Rochester Conference Series on Public Policy* (December 1993), pp. 195-214.

__________. "Policy Rules as a Means to a More Effective Monetary Policy," in *Towards More Effective Monetary Policy*. Iwao Kuroda, ed., St. Martin's Press,1997, pp. 28-39.

__________. "An Historical Analysis of Monetary Policy Rules," in *Monetary Policy Rules*, John B. Taylor, ed., University of Chicago Press, 1999, pp. 319-41.

Thornton, Daniel L. "Nominal Interest Rates: Less than Zero?" Federal Reserve Bank of St. Louis *Monetary Trends* (January 1999), p. 1.

Walsh, Carl E. *Monetary Theory and Policy*, MIT Press, 1998.

Walters, Alan A. "Consistent Expectations, Distributed Lags, and the Quantity Theory," *Economic Journal* (June 1971), pp. 273-81.

Woodford, Michael. "Price Level Determinacy Without Control of a Monetary Aggregate," *Carnegie-Rochester Conference Series on Public Policy* (December 1995), pp. 1-46.