

APPLYING ACADEMIC RESEARCH ON MONETARY POLICY RULES:
AN EXERCISE IN TRANSLATIONAL ECONOMICS

The Harry G. Johnson Lecture

by

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Characterizing monetary policy as a systematic rule in which the instruments of policy--for example, the monetary base or the short run interest rate--react to macroeconomic variables has been common in academic research on monetary policy for nearly thirty years now. Monetary policy rules are naturally amenable to modern econometric policy evaluation methods that were developed as part of the rational expectations revolution in macroeconomics in the early 1970s. When using these methods, researchers first build a structural model of the economy, consisting of mathematical equations with estimated numerical parameter values. They then test out different rules by simulating the model stochastically with different policy rules placed in the model. One monetary policy rule is better than another monetary policy rule if the simulation results show better economic performance--for example, lower variability of inflation and real output--with that rule. In my view this research has greatly improved our understanding of how monetary policy affects the economy and on how monetary policy should be conducted. It has led to new economic theories of how market prices adjust to changing circumstances and of how people forecast the future. The research has also stimulated the development of better computer algorithms to do the stochastic simulations

There is also evidence that this research on monetary policy rules has had a *practical impact* on actual monetary policy, although this is a much more recent development. Central bankers now emphasize the importance of following more systematic policies with clearly-stated credible goals, an emphasis that did not exist until recently. They have become increasingly interested in specific monetary policy rules as a guide to their decisions. Many monetary policy makers routinely use policy rules as inputs to their own policy decisions. It is not unusual now for monetary policy officials to discuss openly the use of specific policy rules in framing their policy decisions and to examine the academic research that has been done on policy rules. For example, Federal Reserve Governors Alan Greenspan (1997), Laurence Meyer (1996), Janet Yellen (1996), and Edward Gramlich (1998) have all given speeches on aspects of monetary policy rules. Moreover, the staffs of central banks are actively doing research on the application of policy rules.¹ And financial market economists are now using policy rules to help analyze and predict monetary policy decisions. It is striking to see how far

¹ Of course, the much of the “academic” research on policy rules referred to in the title of this paper has been done at central banks as well as at universities and other research organizations.

the practical application of policy rules has advanced in such a short period of time.

This lecture is about the application of academic research on monetary policy rules. My main focus is on the *diffusion process* through which the application of this research has come about. Because we are still experiencing this diffusion process in the case of monetary policy rules, it is too early to give an historical perspective. Hence, the lecture is more a progress report on the application of policy rules, with examples from my own personal experience, than a comprehensive analysis. The lecture is thus narrowly focussed. I will concentrate on the process through which the practical application of monetary policy rules has taken place in the United States because I am most familiar with what had been happening there. A full story would include developments in other countries.

1. Preconditions

I believe certain *preconditions* must be satisfied before the practical application of academic economic research can take place. One precondition is that there be considerable agreement among economists about the economic ideas or research pertaining to the application; in order for academic research to have a significant impact in a democracy there must be some consensus about the findings of the research.² A second precondition is that there be a demand for the application of the research by the public, by their representatives, or by the policymakers themselves. In the case of monetary policy rules, these preconditions took the form of (1) a core set of macroeconomic principles about the impact of monetary policy, and (2) a clear political-economic demand for an increased emphasis on policy rules and a corresponding decreased emphasis on discretion. In retrospect, it appears that these two preconditions were being established by the late 1980s or early 1990s.

² A consensus among economists is difficult to define precisely or to demonstrate conclusively. Hence, my characterizations here are necessarily rough and informal. A consensus does not mean that all economists believe something and, of course, a consensus usually changes over time.

A Core of Macroeconomic Principles.

While a consensus that monetary policy should be evaluated as a policy rule has existed for several decades, it is only recently that there has been anything close to a consensus about the macroeconomic theory that would determine the particular form of such a policy rule. In fact, there has been much controversy and debate about macroeconomics during the past thirty years—with researchers seeming to join the real business cycle school, the new classical school, the new Keynesian school, or some other school, even as has agreement about policy evaluation methods has increased.

Recently, however, I think a general consensus has emerged on a several key macroeconomic principles. These principles have guided much of the research on monetary policy rules and has thus made their practical application possible. I would focus on five broad principles.³ These principles lie behind virtually all the structural econometric models (whether estimated or calibrated) that have been built to evaluate monetary policy in recent years. For technical details about these models see Taylor (1993a), Bryant, Hooper and Mann (1993), or Taylor (1998), a National Bureau of Economic Research volume that I am editing).

The first, and most straightforward, principle is that the long-term trend of real GDP is well-described by modern neoclassical growth theory, with the growth rate of productivity depending on capital per hour of work and on technology. Both capital per hour of work and technology are endogenous and are susceptible to changes in economic tax policy, trade policy, and regulatory policy. The trend in real GDP is not constant, but it changes slowly in comparison to shorter-term business cycle fluctuations.

The second principle is that no long-run trade-off exists between inflation and unemployment (or the deviations between real GDP and the long-term trend in real GDP). Here I refer to U.S. experience for evidence: inflation in the 1950s was low and unemployment was also low. Inflation in the late 1960s and 1970s was high and unemployment was no lower than in the 1950s. Finally, inflation in the 1990s is low again and unemployment is not higher than the 1970s. To be sure, we have no evidence on the effect of zero or negative inflation.

Third, a short-run tradeoff exists between inflation and unemployment. There is still debate about the reason for this tradeoff, and about whether it is due to sticky prices or to imperfect information. This short-run trade off

³ See Taylor (1997) for a more detailed explanation of these principles.

means that changes in monetary policy have a short-run impact on unemployment even though monetary policy is neutral in the long run. The size of the short-run impact is uncertain partly because the theoretical rationale for the impact is uncertain.

Fourth, people's expectations of the future matter greatly for the evaluation of monetary policy, and these expectations are endogenous to changes in policy. There is still debate about how to model expectations, but rational expectations had become the baseline assumption. Recent models of learning and transitions to rational expectations can improve on the rational expectations assumption in some cases, but expectations are endogenous in these models too.

These four principles imply a fifth principle that pertains to monetary policy: the monetary authority should choose a *target* inflation rate and the instruments of policy should set in such a way that inflation will stay near that target. A low inflation target is better than a high inflation target. No long run target for the unemployment rate is needed because, according to the second principle above, monetary policy cannot affect the unemployment in the long run. Simply choosing the target inflation rate is not enough because there will always be shocks which will take the economy away from that target. Thus, one needs a set of procedures for changing the instruments of policy in response to these shocks. The procedure can be described by a policy rule. The policy rule for the instruments matters for the fluctuations of both inflation and unemployment because of the third principle that there is a short-run tradeoff. It is important to distinguish between the terms *target* and *rule* in this fifth principle. For example, by the above definition nominal income targeting would not be a policy rule, because it would not describe how the instruments of policy are adjusted; it only refers to the target. Similarly, setting an inflation target does not tell the central bank what to do with its instruments in order to achieve that target.

A Pent-Up Political-Economic Demand for Policy Rules.

A second precondition for the practical application of policy rules is that there be a political-economic demand for reducing discretion and increasing emphasis on policy rules in practical decision making. The principle stated above that expectations matter and are endogenous was enough of a reason for academic researchers to focus their models on the evaluation of policy rules. If people are forward looking then policy rules,

which describe future policy actions, are needed in order to evaluate policy. Without a rule (that is, a contingency plan), there would be no way to gauge these expectations. That rules are needed in order to evaluate monetary policy is an implication of the Lucas “econometric policy evaluation critique.” Researchers have been dealing with the Lucas critique by assuming that people are forward-looking and that policy is described by a policy rule.

But this is a technical (mathematical, statistical, and computational) argument about econometric policy evaluation methods. It is not enough to create a demand by government decision makers—some of whom are not even familiar with the models or the methods—for policy rules. It turns out, however, that there are a host of other reasons why a policy more based on rules and less on discretion has become more desirable. Let me list seven of these briefly.

(1) *Time inconsistency.* The time inconsistency problem calls for the use of a policy rule in order to reduce the chance that the monetary policymakers would change their policy after people in the private sector have taken their actions. Recall that the original Kydland-Prescott paper on time inconsistency emphasized that the problem provided a political-economic rationale for policy rules. That implication of time inconsistency has been reinforced over the years, and has been embodied into much practical policymaking through the increased emphasis on credibility.

(2) *Clearer explanations.* If a policy rule is simple, it can make explaining monetary policy decisions to the public or to students of public policy much easier. It is very difficult to explain why a particular interest rate is being chosen at a particular date without reference to a method or procedure such as would be described by a policy rule. The use of a policy rule can mean a better educated public and a more effective democracy. It can help to take some of the mystique out of monetary policy.

(3) *Less short-run political pressure.* A policy rule is less subject to political pressure than discretionary policy. If monetary policy appears to be run in an *ad hoc* rather than a systematic way then politicians may argue that they can be just as *ad hoc* and interfere with monetary policy decisions. A monetary policy rule which shows how the instruments of policy must be set in a large number of circumstances is less subject to political pressure every time conditions change.

(4) *Reduction in uncertainty.* Policy rules reduce uncertainty by describing future policy actions more clearly. The use of monetary policy rules by financial analysts as an aid in forecasting actual changes in the instruments would reduce uncertainty in the financial markets.

(5) *Teaching the art and science of central banking.* Monetary policy rules are a good way to instruct new central bankers in the art and science of monetary policy. In fact, it is for exactly this reason that new central bankers frequently find such policy rules useful for assessing their decisions.

(6) *Greater accountability.* Policy rules for the instrument settings allow for more accountability by policy makers. Because monetary policy works with a long and variable lag, it is difficult to simply look at inflation and determine if policymakers are doing a good job. Today's inflation rate depends on past decisions, but today's settings for the instruments of policy—the monetary base or the short-term nominal interest rate--depend on today's decisions. Recent examples of the use of policy rules for accountability purposes are the questions about policy rules posed by the U.K. parliamentary committee to the members of the new Monetary Policy Committee of the Bank of England.

(7) *A useful historical benchmark.* A final reason I think policymakers have found policy rules useful is that rules provide a baseline for historical comparisons. For example, if the interest rate was at certain level at a time in the past with similar macroeconomic conditions as today, then that same level would be a good baseline from which to consider today's policy actions.

In my view these factors—the recognized importance of expectations and the other seven--have created a demand for monetary policy rules and have thus helped establish the preconditions necessary for the practical application of policy rules in recent years.

2. Translational Economics

While these two preconditions—a practical theoretical core and clear political-economic need—are necessary for the practical application of academic research to public policy, they are not sufficient. There are plenty of good economic ideas “out there on the shelf” that do not affect practical decision making. Some direct actions, perhaps by those working in the policy arena or perhaps by people close to policymaking, are needed to take the academic research and mold it into something useful for policymakers.

An analogy with research in the physical sciences might be useful. Consider biology. Some research in a biological laboratory may result in

useful medical applications. Much of it does not. To find ways to make such research useful, someone has to find a way to mold the research findings into some medical product that will benefit human beings; it is necessary to be familiar both with the laboratory research and with people's medical needs in order to do so. The process of finding ways for the research in the biology laboratories to be applied in medicine to improve people's health is called "translational biology." Analogously the term *translational economics* might usefully designate the process of finding ways to make academic research in economics applicable to improving the performance of an economy.

I think it is difficult to generalize about the nature of translational economics. Many people are involved in such endeavors and their actions are varied. Many times the people and the actions are hardly noticed at the time. Sometimes the key actions occur in a crisis atmosphere in which policy makers need a quick solution to a problem and are ready to take an idea off the shelf. Rarely are these activities recorded.

It seems that the most useful way for me to contribute to the description of translational economics—and the most appropriate for this lecture—is to draw on my own experience with the application of monetary policy rules. I had the opportunity to work in the policy arena as a Member of the President's Council of Economic Advisers (CEA) in Washington the late 1980s and early 1990s. The CEA does not, of course, have responsibility for monetary policy. But as a member of the CEA, part of my job was to be informed about the stance of monetary policy, to help develop an administration position on monetary policy decisions, and to describe how such decisions fit into the overall administration's economic policy.

For example, during the 1990 budget deal in which the Administration and Congress reached an agreement to raise taxes and reduce spending, it was important to know what if anything the Fed would do and under what circumstances. Carrying out these responsibilities meant developing working relationships with the Federal Reserve governors, other members of the Federal Open Market Committee, and the Fed staff. Through many meetings and consultations with Fed officials I came to learn quite a bit about how monetary policy decisions were being made at that time, including the role of research in informing the decisions of the governors and the staff.

The Research-Practice Gap and the “Greenspan Standard”

In the years before I joined the CEA, I was a faculty member at Stanford University where most of my research was on rational expectations policy evaluation research. During the 1980s I had extended a simple rational expectations model into a multicountry model better suited to the evaluation of monetary policy rules. One of the most striking recollection of the early days of that Washington experience was the big gap between the way monetary policy research was proceeding in academia and the way monetary policy was being conducted in practice. In particular, although virtually all academic policy evaluation research had been focussing on policy rules, none of my early discussions about policy with Federal Reserve officials were conducted with reference to policy rules.

While the monetary aggregates had been emphasized for a while when Paul Volcker was head of the Federal Reserve Board, the aggregates were gradually being de-emphasized again as the velocity of both M1 and M2 was becoming less stable. As if to highlight the fact that discretion was overtaking rules once and for all, many commentators spoke at that time of monetary policy following the “Greenspan standard,” a reference to the way in which Federal Reserve Chair Alan Greenspan seemed to manipulate the short term interest rate in a purely discretionary fashion.

I was concerned that the policy evaluation research, on which I and many other economists had been working, appeared, at least on the surface, to be having so little impact in practice. There were two problems that I was concerned about. The first was a perception problem. The reality was that certain policy makers at the Fed were in some small ways implicitly viewing their interest rate decisions as part of systematic response to economic developments. The deliberate tightening of monetary policy, as inflation began to pick up and the economy moved above its potential in 1988 and 1989, reflected this view. This view and these decisions could, of course, have been influenced by academic economic research. But whether they were or not, my concern was that the decisions were being characterized by monetary analysts as purely discretionary. In fact, proponents of more discretion were using the Greenspan standard to tout discretionary policies. It was clear to me that these decisions could be characterized as having rule-like features, though Federal Reserve officials would be unlikely to give it such a characterization.

The second problem was that any rule-like features of policy decisions that existed were qualitative rather than quantitative. They were more like the

traditional of a “lean against the wind” response stated by Fed officials for many years in which neither the amount of leaning, the definition of the wind, nor measurement of the wind were specified.

I decided that I should take some direct action to reduce this research-practice gap. As a member of the CEA I felt like I had an opportunity to move the policy “ball” at least a little bit in the direction of the policy rule “goal line,” an opportunity that would not exist outside the policy arena. One plan of action was to use the public forum offered by the annual *Economic Report of the President* to make the case for monetary policy rules, by both showing how Fed actions could be described in terms of a policy rule and by stipulating the advantages of doing so. My colleagues on the CEA, Michael Boskin and Richard Schmalensee enthusiastically went along with the idea. Fortunately, we had the practical expertise of Brian Madigan, an economist “on loan” to the CEA from the monetary affairs division of the Federal Reserve to help carry out the plan.

A Manifesto for Systematic, Credible Policies with Some Discretion

The result was Chapter 3 of the *1990 Economic Report of the President*, in which the Council of Economic Advisers translated academic research on policy rules into a form potentially useful for policymakers to use in practice. In essence, the case for monetary policy rules was being made in a political environment and as part of an official political document. Why is the *Economic Report of the President* a political document? Because it is a statement of an elected president’s economic policy and because it is vetted within the administration and cleared by all relevant departments and agencies of government, including the Federal Reserve Board.

Translating academic research on policy rules into such a political document is not easy. First, such documents are not technical and any detailed reference to research must be explained in non-technical language. Perhaps this is a feature of translational economics that is less important in translational biology. More importantly, in discussing policy rules we needed to make it clear that neither the CEA or the President was advocating replacing the Fed with some mechanical formula. Regardless of how any of the economists on the CEA felt, such an advocacy position would be impossible to propose as serious administration policy at that time. Moreover, for any monetary policy rule to actually be applied, it had to preserve some element of discretion by the monetary authorities. We were

also constrained somewhat by the pejorative connotation of the word “policy rule” in some circles. Some people thought using a policy rule meant turning monetary policy over to a computer. For this reason we decided to use a completely different terminology; we decided to use the term *systematic* policy in place of policy rule. “The concept of a systematic policy,” the report stated, “is much broader than a simple or even complex numerical formula.” And the *Economic Report of the President* made it perfectly clear that if such a rule was adopted by the Fed it would be as a guideline, and would that discretion would be needed to implement the policy rule. The 1990 Report thus stated, “a policy approach that relies on the expertise of the FOMC members is appropriate and should be preserved.”

Some of the section titles from Chapter 3 give a sense of its contents: *The Design of Macroeconomic Policy, The Advantages of Systematic Policies, The Importance of Credibility, Credibility and Disinflation, Credibility and Economic Uncertainty, Achieving Policy Credibility*. The importance of distinguishing between the short-term and the long-term inflation trade-off was described. Terms such as “time inconsistency” were explained and used in the report.

The Report did not recommend any particular policy rule, however. Rather it pointed out that “the Federal Reserve generally increases interest rates when inflationary pressures appear to be rising and lowers interest rates when inflationary pressures are abating and recession appears to be more of a threat.” The Report implied that a policy of this general form was likely to be a good policy. The size of the interest rate response to inflation or real output was left to the “judgement” of monetary policymakers, although studies were being conducted to determine how large that response should be.

There was a fair amount of reaction to this policy rules manifesto in Chapter 3 of the *1990 Economic Report of the President*. A front page story in the *Wall Street Journal* focussed on the CEA recommendation that systematic monetary policies be emphasized at the expense of discretion. Several undergraduate textbooks (for example, Colander (1995)) incorporated the material from the *1990 Economic Report of the President* as examples of a modern applied case for using policy rules in practice. To quote Colander (1995, p. 325), “A good way to see how New Classical and New Keynesian ideas have affected macroeconomic policy, or at least thinking about macroeconomic policy, is the discussion of macroeconomic policy in the *1990 Economic Report of the President*....The economists writing the report wanted to emphasize that one cannot think of macroeconomic policy without thinking about what effect expectations of

macroeconomic policy will have. The policy must be credible, systematic and consistent.” Some members of the Federal Reserve Board were found favorably quoting from the report and several more offered thanks to the CEA for the clear explanation of the rationale for monetary policy rules. The CEA was also pleased to get a letter of support from Robert Lucas expressing the view that the CEA’s effort represented genuine progress.

In retrospect, it appears to me that this exercise in translational economics found in the *1990 Economic Report of the President* helped to smooth the way to the application of policy rules in practice. Perhaps most importantly it removed some institutional fears on the part of Fed policymakers that using a policy rule as a guideline would remove all discretion from policymaking. But the actual application of the academic research on policy rules in policymaking deliberations at the Fed was still far from a reality. Policy rules were still rarely discussed by Federal members of the FOMC when they were deciding whether to raise or lower the federal funds rate.

3. From Complex Models to a Very Simple Monetary Policy Rule

Soon after I returned from Washington in 1991 I again began to think about how to bring the academic research into practice. I completed a book on using an econometric rational expectations model to evaluate monetary policy rules, a project that I started in the mid-1980s before I had left for Washington (Taylor 1993a), which was in turn an extension of research I began in the 1970s.

A major breakthrough in the practical application of policy rules can be attributed to a model comparison project that was organized and summarized in an important book by Bryant, Hooper and Mann (1993). I had been interested in such a policy rules comparison for a long time, because of the robustness and possible consensus a model comparison project would bring to academic research on policy rules. The Bryant, Hooper, Mann (1993) comparison of policy rules grew out of earlier model comparison projects I had participated in with my multicountry model.

The model comparison project brought many rational expectations models, including my own multicountry model, together to evaluate different monetary policy rules. By 1992 the Bryan, Hooper and Mann book was complete and ready for publication. But this research was still very technical.

No one policy rule was obviously emerging from this work. Moreover, some commentators criticized the effort as merely pointing out how much disagreement there was among economists about the appropriate monetary policy rule. True, at cursory glance, the results showed considerable differences in results across models. But it seemed to me that more of a consensus could be gleaned from the results. Perhaps there was even a consensus policy rule that could capture key results from the simulations of many different models. If so, that would increase the potential for practical application of policy rules much more than if the results were based on a single model such as my own.

Alan Meltzer's invitation to present a paper on using policy rules in practice at the November 1992 Carnegie Rochester Conference on Public Policy in Pittsburgh gave me the opportunity to study the model comparison results further and at the same time try to be more specific than we were in the *1990 Economic Report of the President* about what a good policy rule would look like. I knew from my experience in Washington that the effort to bring policy rules into practice would require proposing a simple, easy-to-understand policy rule. The simpler the better. Such a rule could then be compared with actual policy during different historical periods, and policymakers could make an assessment about how a policy rule would have worked compared with actual policy.

In looking through the simulation results from the different models reported in Bryant, Hooper and Mann (1993) and at my own simulations, I noticed that the policy rule research for the United States had three general characteristics: (1) an interest rate instrument performed better than a money supply instrument, (2) interest rate rules that reacted to both inflation and real output worked better than rules which focussed on either one, and (3) interest rate rules which reacted to the exchange rate were inferior to those that did not. To be sure this characterization is a generalization, but nonetheless I would say it reflected the simulation results.

To get a simple rule that had these characteristics I then chose the four-quarter inflation rate as a measure of inflation and real GDP deviations from trend for a real output measure (these choices could be justified from the model-based research). I then set the weights in the rule so that the real short-term interest rates would adjust by the same amount to inflation and to real GDP. The simple rule I came up in the Carnegie-Rochester paper, now usually called the Taylor rule, was:

$$r = \pi + (y - y^*)/2 + (\pi - 2)/2 + 2$$

where

r = federal funds interest rate,
 π = inflation rate (four quarter average),
 y = real GDP ($100 \times \log$),
 y^* = potential GDP ($100 \times \log$).

The equation is certainly simple: only two variables, no lags, and the numerical coefficients are easy to remember (all the numbers are two's!). The target inflation rate is 2 percent, the guess at the real interest rate is 2 percent. The weights on inflation and real output are $\frac{1}{2}$ and $\frac{1}{2}$.

The equation was not fit to the data in the sense of a regression, but it described actual Fed behavior fairly well during the Greenspan period up to 1992. One could of course get a better fit of the equation using regression techniques, especially if one used lagged variables and added more terms, but the equation was meant to be a normative recommendation of what the interest rate should be, a recommendation that Federal Reserve officials could use to help formulate policy. The discrepancies between the equation and reality could be a measure of discretion, either for good or for bad. One small, but noteworthy, discrepancy was when policy eased during the 1987 stock market crash in a way not captured by the policy rule, a discretionary action that seemed quite appropriate then and still seems appropriate.

This policy rule for the interest rate instrument is not the only policy rule that has been proposed in recent years. Ben McCallum had proposed a monetary base rule, an effort which also helped in the application of the academic research on policy rules. However, because the Federal Reserve (and other central banks) had been conducting policy in terms of the interest rate rather than the monetary base, the interest rate rule generated considerable interest.

4. The Increased Interest in Monetary Policy Rules

Although the purpose of the above policy rule is normative rather than positive, it did describe, as I already noted, actual Federal Reserve actions very well during the Greenspan years from 1987 to 1992. Moreover, monetary policy since 1992 has also been well-described by this policy rule,

certainly much better than policy in early periods of U.S. monetary policy. Versions of the policy rule have also described the behavior of the Bundesbank and other central banks fairly accurately (see Clarida, Gali, and Gertler (1997)). In other words, it appears that, whether or not central banks actually follow such a rule, in recent years they act *as if* they follow such a rule. This was not always the case. In the 1970s the Fed deviated by very large amounts from this rule and this is precisely the time that inflation picked up.

If we look at the years during which monetary policy is well-described by this policy rule, the U.S. economy appears to be more stable than at any other time in its history. The current expansion in the United States is already the second longest peacetime expansion in U.S. history, and it may soon be the first longest. This expansion, which began in April 1991, is already 7 years old. But what is even more significant is that the first longest peacetime expansion in U.S. history was one right before the current one. In other words the U.S. economy has experienced—back-to-back—its two longest peacetime expansions in its history, and these were separated by a short recession. Moreover, the inflation rate appears to be more stable than at most previous historical periods in the past.

In retrospect, I think this close correlation between the Federal Reserve's action and the policy rule during the recent good economic period has been an important factor generating interest in policy rules. In other words, two facts (1) that monetary policy performance during the Greenspan period has been good and (2) that a simple policy rule described that behavior well added to the attractiveness of such a rule as potentially guiding policy.

There are many indications of this interest. Private sector economists--at Salomon Brothers, The Bank Credit Analyst, Allstate Insurance, Dresdner Bank, Goldman Sachs, Chase Manhattan, Midland Bank, for example--have begun using this type of policy rule to analyze Fed behavior.

The St. Louis Federal Reserve Bank, which has carefully been collecting and publishing data on the monetary base for many years, has begun publishing the results of policy rules along with other monetary policy indicators.

The Federal Reserve staff now regularly presents the recommendations of such policy rules to the Federal Open Market Committee in preparation for its meetings to decide whether or not to raise or lower the federal funds rate. To be sure, the result from a policy rule is one of several inputs that the members of the FOMC examine when considering a decision, and there is no way to know for sure how much the results guide the decisions.

The staff of the Federal Reserve System is doing much research on monetary policy rules. For example, simulations of their new rational expectations models indicate that the response coefficient (with a value of $\frac{1}{2}$) for the interest rate reaction to real GDP in equation (1) is too low. The new simulations also indicate that the response of the interest rate should be smoothed out with a partial adjustment mechanism by adding a lagged interest rate to the equation. The use of rational expectations models for policy evaluation research at the Fed is additional evidence that policy rules have risen in importance at the Fed.

Federal Reserve Board governors have begun to talk about the usefulness of policy rules. For example, Janet Yellen (1996, p. 10), who was a member of the Board of Governors before moving to the Council of Economic Advisers in 1997, has stated, "...rules provide a simple but useful benchmark to assess the setting of monetary policy in a very complex and uncertain economics environment." More recently, Alan Greenspan (1997, p. 7) has stated that "we try to develop as best we can a stable conceptual framework, so policy actions are as regular and predictable as possible—that is, governed by systematic behavior but open to evidence of structural macroeconomic changes that require policy to adapt."

Greenspan's remarks about the appropriate size of the reaction of the interest rate to real GDP and inflation demonstrates the usefulness of thinking about monetary history from the perspective of a policy rule like equation (1). Greenspan (1997, pp. 4-5) considers what the size of the interest rate response to real output would be with a constant money growth rate policy. In commenting on such a money growth policy, Greenspan stated: "Because the velocity of such an aggregate [M1] varies substantially in response to small changes in interest rates, target ranges for M1 growth in [the FOMC's] judgement no longer were reliable guides for outcomes in nominal spending and inflation. In response to an unanticipated movement in spending and hence the quantity of money demanded, a small variation in interest rates would be sufficient to bring money back to path but not to correct the deviation in spending." (pp. 4-5). In other words, the interest rate elasticity of money demand is too large; it implies that the interest rate would respond by too small an amount to an increase in output, presumably by less than in equation (1) which describes the Fed's reaction during this period.

5. Concluding Remarks.

In this lecture I have examined the path that research on monetary policy rules has taken as it has moved from the halls of academe to the corridors of monetary policy decision-making. Of course this description is only part of the story and from only one perspective. Others may have a much different perspective and may fill in parts of the story about which I am unfamiliar.

I think it is indisputable that substantial progress has been made in the application of monetary policy rules in practice during the 1990s: The Federal Reserve acts as if it follows a policy rule. The private sector assumes that Federal Reserve policy actions can be described by a policy rule. Policy rules help inform members of the FOMC about their interest rate decisions. The Federal Reserve staff is doing active research on monetary policy rules. Several Fed governors—including the Fed chair—have discussed policy rules in recent public discussions. To be sure the Fed does not use any policy rule mechanically to determine interest rates. The policy rules are more like guidelines.

The process by which economic research gets applied to solve real world problems is a fascinating one. I have tried in this lecture to shed a bit of light on the process by demonstrating that is an essential part of economics and by drawing on some of my own experiences in research and policy. I hope my lecture demonstrates the importance of basic economic research, such as that presented in the excellent papers at this conference, for policy making. But I also hope the lecture demonstrates the importance of what I have called *translational economics*, a subject that has received relatively little attention in the economics profession.

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