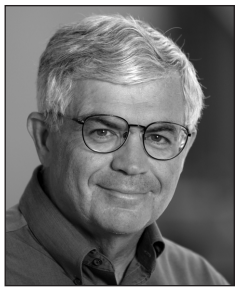
The Explanatory Power of Monetary Policy Rules

SIMPLE PRINCIPLES HAVE BIG IMPACTS

By John B. Taylor



John B. Taylor is the Mary and Robert Raymond Professor of Economics at Stanford University and the Bowen H. and Janice Arthur McCoy Senior Fellow at the Hoover Institution. He is a member of the California Governor's Council of Economic Advisors. Previously, he was director, Stanford Institute for Economic Policy Research, where he is now a senior fellow, and was founding director of Stanford's Introductory Economics Center. Previously, he served on the President's Council of Economic Advisers, the Congressional Budget Office's Panel of Economic Advisers, and as Under Secretary of Treasury for International Affairs. He held positions as professor of economics at Princeton University and Columbia University. His academic fields of expertise are macroeconomics, monetary economics, and international economics. He has won a number of awards for distinguished public service, as well as for outstanding teaching. He is a fellow of the American Academy of Arts and Sciences and the Econometric Society and served as vice president of the American Economic Association. He received a B.A. in economics summa cum laude from Princeton University and a Ph.D. in economics from Stanford University.

Over the past 20 years, the use of monetary policy rules has become pervasive in analyzing and prescribing monetary policy. This paper traces the development of such rules and their use in the analysis, prediction, and stabilization of national economies. In particular, rules provide insight into eras in which monetary policy was not effective as well as when it was, such as the persistence of the ongoing "Great Moderation." The paper stresses the "scientific" contributions of rules, including their insight into fluctuations of housing construction and exchange rates, as well as into the term structure of interest rates.

It is an honor to be here today to receive the Adam Smith Award, and it is a pleasure to give the Adam Smith Lecture. Everything I have read about Adam Smith tells me that he was passionate about his research and that his passion spilled over into his lectures. Many years ago, Woodrow Wilson wrote about Smith's lecture style in his essay, *The Old Master*. As then Professor Wilson put it, "[Smith] constantly refreshed and rewarded his hearers…by bringing them to those clear streams of practical wisdom and happy illustration which everywhere irrigate his expositions." You may have heard that Adam Smith would visit my introductory economics lectures at Stanford from time to time, interrupting me and speaking enthusiastically from the heavens. Well, it wasn't really Adam Smith. It was my own recording of his voice

This paper was delivered as the Adam Smith Award Lecture at the NABE Annual Meeting, September 10, 2007, San Francisco, California.

piped through the lecture hall PA system. "Professor Taylor, Professor Taylor" the voice would say in an exasperated tone. "You told your students about economies of scale, and you didn't even mention my famous story of the pin factory. Well let me tell them about it." And then the students would listen to him reading out loud his famous, clear, practical story from the *Wealth of Nations*.

In this lecture I would like to discuss a long-time—forty years actually—research interest of mine: monetary policy rules. And I hope you will excuse me if I have trouble containing my own passion for this subject. I want to take the opportunity to step back and look at how a vast amount of recent theoretical and practical work on monetary policy rules by economists in academia, government, and business has influenced the broader "scientific" landscape of monetary and financial economics. Several years ago, the *Wall Street Journal* published a story by David Wessel on monetary policy rules. To be specific, it was about what they called the Taylor rule. It was headlined, "Could One Little Rule Explain All of Economics?" Today I will argue that, while monetary policy rules cannot, of course, explain all of economics, they can explain a great deal.

1. Origin and Use of Monetary Policy Rules

What is a monetary policy rule? At its most basic level, it is a contingency plan that lays out how monetary policy decisions are, or should be, made. Let me start with the example of the Taylor rule. It says that the short-term interest rate equals one-and-a-half times the inflation rate plus one-half times the real GDP utilization rate plus one. So, in 1989, for example, when the federal funds rate was about ten percent in the United States you could say that the ten percent was equal to 1.5 times the inflation rate of five percent (or 7.5) plus .5 times the GDP gap of about three percent (or 1.5, which takes you to nine) plus one, which gives you ten. Now, this is a very specific rule, and it can be written down mathematically as shown in equation 1. It can also be expressed by equation 2, which is the way the rule was written when first presented in 1992.

$$(1) \qquad r = 1.5p + 0.5y + 1, \text{ or}$$

$$(2) \qquad r = p + 0.5y + 0.5(p - 2) + 2,$$

where r is the federal funds rate,
p is the inflation rate,
y is the real GDP gap

Of course, I did not name it the Taylor rule. Others did that later. Originally, the rule was meant to be normative: a recommendation of what the Fed should do. It was derived from monetary theory, or more precisely from optimization exercises using new dynamic stochastic monetary models with rational expectations and price rigidities. Like most rules or laws in economics, it is not as precise as most physical laws, though that does not mean it is less useful. It was certainly not meant to be used mechanically, though it now appears that monetary policy might operate even better if it stayed closer to the rule. Figure 1 shows how the inflation rate and GDP fed into the policy rule using the same illustrations and data I used in 1992. They described actual monetary policy very well during the brief 1987-91 period, but that in itself was not as surprising as what came later.

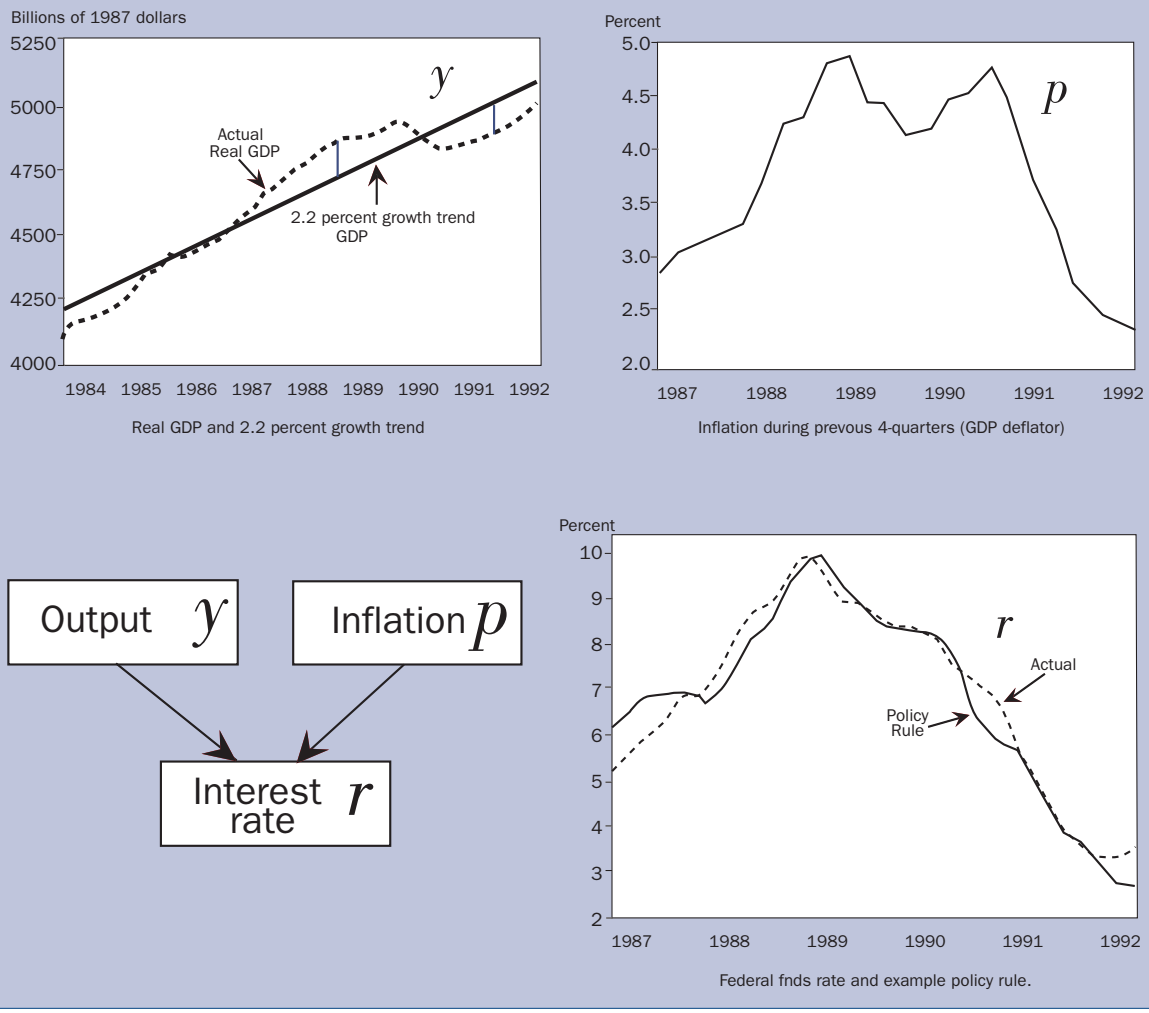
Now, there are many other monetary policy rules. Milton Friedman's constant growth rate rule said to hold money growth constant and let the interest rate go where it might. But the kind of rule I am discussing here and which has become so ubiquitous in recent years has the interest rate on the left hand side, and that is a big difference. There are also other monetary policy rules for setting the interest rate. Some look at forecasts of inflation and real GDP rather than their current values. Others gradually adjust the federal funds rate. Still others react to the price level rather than to the inflation rate. But they are all very similar in that they describe the settings for the interest rate.

There has been a great debate over the years about the use of monetary policy rules; they were not always so pervasive, and there was a great deal of resistance to them at central banks. When I was in graduate school in the early 1970s, the textbook in monetary theory was Don Patinkin's *Money, Interest, and Prices*. If you flip through that book you will not find any references to monetary policy rules, except token mention of the Friedman rule. Certainly there were no references to interest rate rules. In contrast, consider the modern day equivalent, Michael Woodford's *Interest and Prices*. It is about nothing but monetary policy rules. Literally thousands of articles and papers have been written on monetary policy rules. The staffs of the Fed and other central banks use policy rules. Even if they do not like to talk about the use of policy rules in their own decision-making, central bankers assume that other central banks follow such policy rules when they make forecasts and assess trends. Just last week, at the annual Jackson Hole conference, Federal Reserve Governor Mishkin discussed policy rules and how they could be improved. It is hard to find a research paper on monetary policy that does not use a monetary policy rule in some form.

The breakthrough in the resistance to the practical use of policy rules appears to have occurred during the period between the late 1980s and the early 1990s. Historians of monetary thought can analyze why the change occurred. Academic work on the Lucas critique and time inconsistency may have been factors, but those ideas were over a decade

FIGURE 1

TAYLOR RULE: REPRODUCTION OF ORIGINAL 1992 DIAGRAMS



old by the late 1980s. An important reason for the breakthrough, in my view, was that, following the Fed's aggressive disinflation effort under Paul Volker's leadership, there was a need for a practical framework—a practical rule—for setting interest rates in order to keep inflation low.

But whatever the reasons, let us examine some of the consequences of this development for our understanding of monetary and financial phenomena.

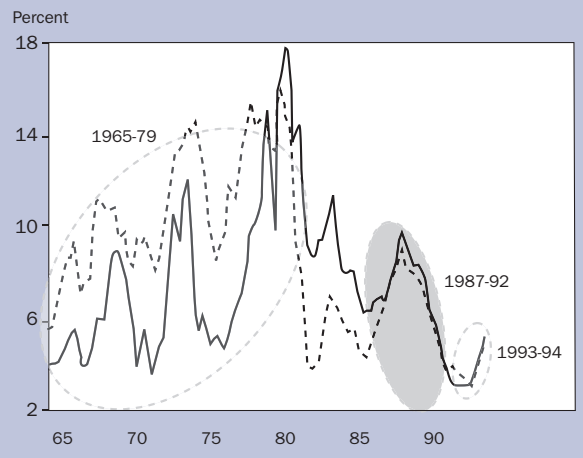
2. Surprising Predictions, Good and Bad

The first thing to observe is that policy rules turned out to be pretty accurate at predicting future interest rates. I illustrate the surprising aspects of this in Figure 2, where I reproduce a very interesting chart originally published in March 1995 by John Judd and Bharat Trehan at the research department at the Fed here in San Francisco. This was published 2-1/2 years after I first presented the Taylor rule in November 1992. I had nothing to do with this chart. I can't remember when I first saw it, but I went back and found it because I thought it would be a good way to illustrate my point. It includes data for the period I looked at in 1992, which I enclose with the oval shaded, but also for the period back to the early sixties and then up to the present (1995).

As Judd and Trehan report in their paper, "Taylor had already shown that his rule closely fit the actual path of the funds rate from 1987 (when Alan Greenspan became Fed Chairman) to 1992 (when I did my original study). Figure 2 shows that the same close relationship continued to hold over 1993 and 1994 as well." I show this by the small oval around 1993 and 1994. This was probably the most amazing thing to observers at the time because obviously, no-

FIGURE 2

FEDERAL FUNDS RATE: ACTUAL VS. RULE'S PRESCRIPTION FOR FED BEHAVIOR



Source: "Has the Fed Gotten Tougher on Inflation?" The FRBSF Weekly Letter, March 31, 1995 by John P. Judd and Bharat Trehan of the San Francisco Fed

body had any idea that this was going to happen back in 1992. If they try, economists can always fit equations very well to past data—during the "sample period," but rarely do things come out so well in the future, after the work is done. So it was a scientific validation of the approach.

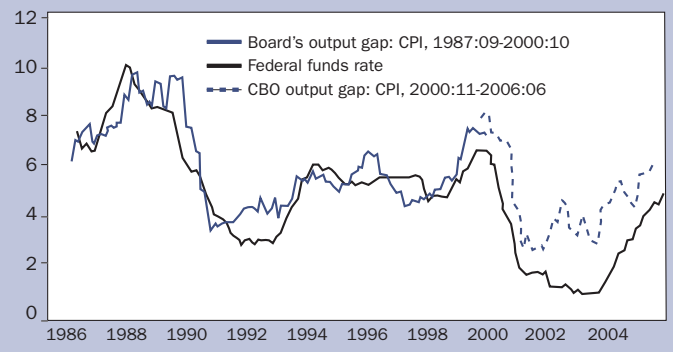
Moreover, you seemed to be getting more out of policy rules than you were putting in, which is a sign that you had something. Recall that policy rules were derived from monetary theories which suggested that they would lead to good macroeconomic results: low inflation and output variability. The rules were not designed to be useful for forecasting. They were meant to be normative, not positive, yet now they were mysteriously shown to be both. Figure 3, which is drawn from a paper published by Bill Poole, President of the Federal Reserve Bank of St. Louis, shows that this general ability to track continued over the years, though not as well as Judd and Trehan had found in 1993-94. Note also that there are some particularly interesting periods where the actual policy deviates from the rule, especially in 2003-2005, an issue which I will return to.

In any case, this predictive value obviously interested business economists and policy makers, especially those working in the financial markets. John Lipsky, then at Salomon Brothers, wrote newsletters as early as 1993 that used monetary rules to forecast and analyze Fed decisions. Gavyn Davies at Goldman Sachs soon applied them to other countries. Janet Yellen, then a member of the Board of Governors of the Fereal Reserve, discussed policy rules at the Federal Open Market Committee in 1995 and referred to monetary policy rules in a speech at NABE in March 1996, mentioning their predictive power.

Another surprising feature of the predictions was discovered by Judd and Trehan by looking back at the 1960s and 1970s, which I show by the big oval in Figure 2. During this period the rule does not fit very well. In fact it is a terrible fit. It would have predicted very poorly during this period. Generally speaking, the actual interest rate is way too low compared to what the rule says it should be. But this finding was interesting, because it was during this early period that monetary policy was delivering pretty lousy results: inflation was high and volatile, and there were many business cycles.

FIGURE 3

GREENSPAN YEARS: FEDERAL FUNDS RATE AND TAYLOR RULE
(CPI p* = 2.0, r* = 2.0) a = 1.5, b = 0.5



Source: From William Poole, "Understanding the Fed" St. Louis *Review*, Jan/Feb 2007

Figure 2 shows that monetary policy decisions were quite different in the period before the early 1980s. But is it possible to determine more precisely what exactly was different about policy? Was it too responsive to changes in the economy or not responsive enough? And did the size of the response differ for inflation versus real GDP? The mathematical form of monetary policy rules enables one to answer such questions. By regressing the short-term interest rate on inflation and output one finds that the response coefficients on both inflation and real GDP were much smaller in the earlier period. Figure 4 illustrates that the coefficients nearly doubled, though the precise size of the increase varies from study to study. Thus, policy became much more responsive regarding inflation and real GDP. Figure 5 shows an example of this increased responsiveness. In the late 1960s when inflation was rising above four percent, the federal funds rate was still under five percent. In the late 1980s when inflation rose to that same level, the interest rate

FIGURE 4

GROWTH OF RESPONSE COEFFICIENTS TO BOTH INFLATION AND OUTPUT

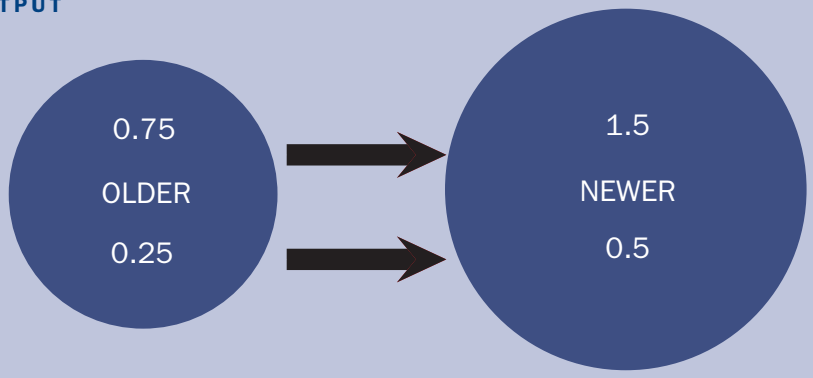
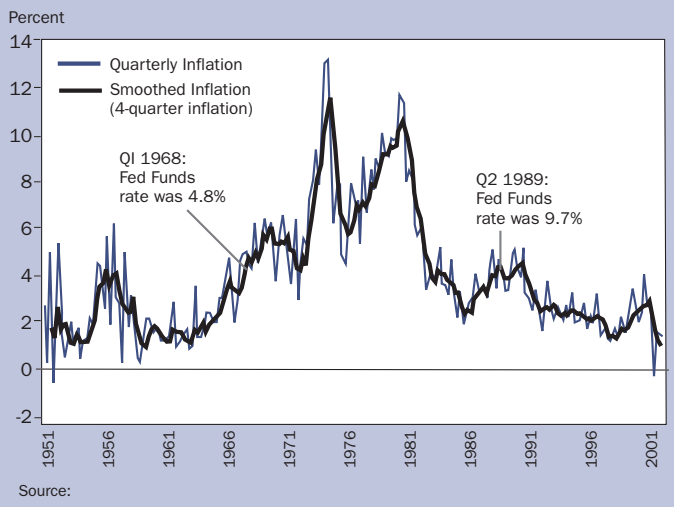


FIGURE 5

INFLATION IN THE UNITED STATES AND THE FEDERAL FUNDS RATE: TWO ERAS



Source:

rose to nearly ten percent. Thus, policy moved toward the policy rule by increasing both the response coefficients on inflation and GDP. They started out too small and grew, rather than starting out too big and shrunk.

3. Explaining the Great Moderation

Having looked at the predictive power of monetary policy rules let me now consider their capability of explaining economic phenomenon that would otherwise be difficult to explain. Perhaps the most important macroeconomic event in the last half century has been the remarkable decline in the volatility of inflation and real GDP. Economists call this the Great Moderation or the Long Boom. Econometricians have determined that the change occurred in the early 1980s, which is what one observes clearly in Figure 6. There were recessions every three a four years in the earlier period, a remarkably poor performance compared to what has happened since. The theory of policy rules has provided a good explanation of this phenomenon, as discussed recently by Ben Bernanke (2004).

The elements of the explanation are based on the observed changes in the policy rule coefficients, illustrated in Figures 4 and 5. During the period of the Great Moderation the monetary policy response of the interest rate to increases in inflation and to real GDP was much larger than in the period of poor economic performance. So there is a clear difference between the policies in the two periods. And the change in policy occurs at the time the economic performance changed. So the timing is right. To complete the explanation, one notes that according to monetary theory the greater responsiveness leads to more stable inflation and more stable real GDP. In fact, that the response was greater than one in the later period has become an important principle of good monetary policy.

To be sure, there are rival explanations for this phenomenon (globalization, increased service production), but none fit the facts so closely.

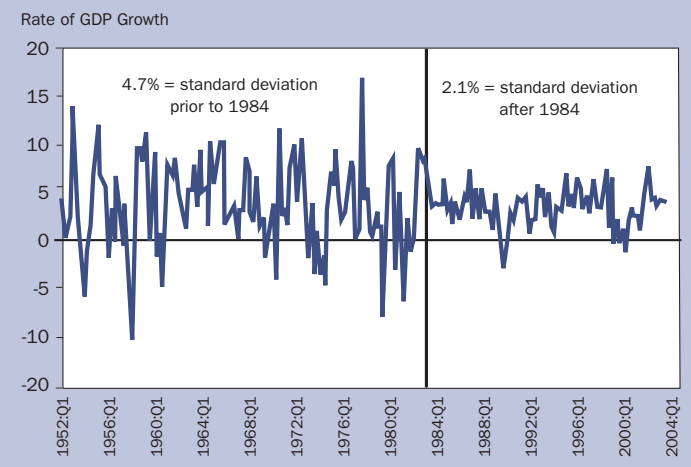
4. And the Great Moderation of Housing Volatility

Figure 7 shows that there has also been a great reduction in housing volatility. Before the early 1980s the standard deviation of residential investment relative to trend was around 13 percent; in the later period it was only five percent, and this includes the most recent fluctuation, which is quite large. In fact, housing volatility came down more than the volatility of GDP and, thereby, more than the other components of spending. The theory of policy rules explains this too.

The explanation starts with the explanation for the Great Moderation. By reacting more aggressively to increases in inflation the Fed has prevented inflation from rising as much as in the past, and this has reduced the ultimate size of the interest rate swings. Again using the Taylor rule, the response coefficient to inflation has increased from less than one to greater than one, and the response coefficient to real output has also increased. These larger responses have thus reduced the boom-bust cycle and the

FIGURE 6

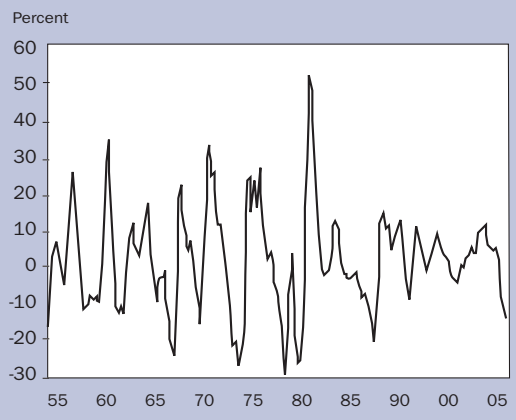
THE GREAT MODERATION OR THE LONG BOOM



Source: Federal Reserve Board

FIGURE 7

PERCENTAGE CHANGE IN RESIDENTIAL INVESTMENT (over previous four quarters)



large fluctuations in interest rates that had caused the large volatility of housing. The reduction is larger than for the other components of spending because housing is more sensitive to interest rates. Another possible explanation is that housing became less impacted by a given change in the federal funds rate due to securitization and deregulation of deposit rates. But that alternative does not stand up because the effect of changes in the federal funds rate on housing show no evidence of a shift between these two periods. Moreover, no other explanation I am aware of has the timing so precise.

5. It Works in Other Countries Too

Another striking finding is that the theory of policy rules seemed to work in other countries too. I don't think anybody anticipated that 15 years ago. Figure 8 is a nice illustration, drawn from a paper published earlier this year by a group that includes both business economists and academics. It shows the deviations from the Taylor rule in the United States, Germany, U.K., and Japan. It shows how off they were up until around 1980 and then how much closer they have been since then. It shows that the same type of chart used by Judd and Trehan (Figure 2) in 1995 would describe events in these other countries. Moreover, these countries also experienced a great moderation, with timing different from country to country.

While the results in these figures pertain to developed countries, the policy rule concept has also been useful for understanding monetary policy developments in emerging market countries for which they were clearly not designed explicitly. In these countries, monetary policy rules have been especially useful for implementing inflation targeting. There are very few countries around the world where someone has not tried to see if monetary policy rules work there.

6. Explaining Exchange Rates Puzzles

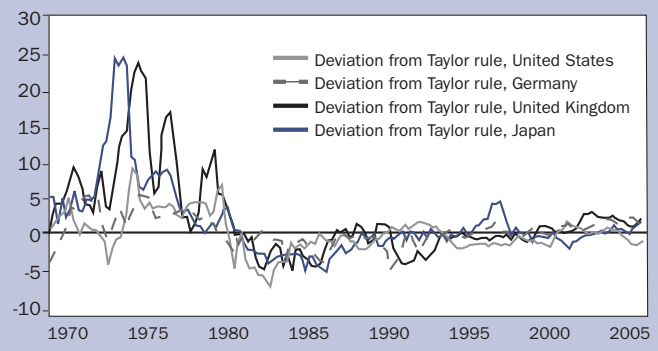
What else can we understand with monetary policy rules? When the U.S. inflation rate rises by more than people in the markets anticipate, you usually see the dollar appreciate. At least that's been the case since the early 1980s, when monetary policy rules have described Fed behavior. What has puzzled economists about this correlation is that, according to purchasing power parity theory, a higher price level should mean a depreciation of the currency. But if you bring a policy rule into play you get a nice, simple explanation of what is going on. You see that as the inflation rate rises, the Fed will increase interest rates (according to the policy rule), and that will tend to make the dollar more attractive, so it appreciates. Engel and West (2006), Engle, Mark, and West (2007), and Clarida and Waldman (2007) have been showing in detail how this and other related exchange rate phenomenon can be explained by policy rules.

7. Explaining Term-Structure Puzzles

Policy rules also help explain certain puzzling features of the term structure of interest rates, as shown by Fuhrer (1996) and Ang, Dong, and Piazzesi (2005). For example, Smith and Taylor (2007) empirically document a large secular shift in the estimated response of the entire term structure of interest rates to inflation and output in the United States. As shown in Figure 9, the impact of inflation and

FIGURE 8

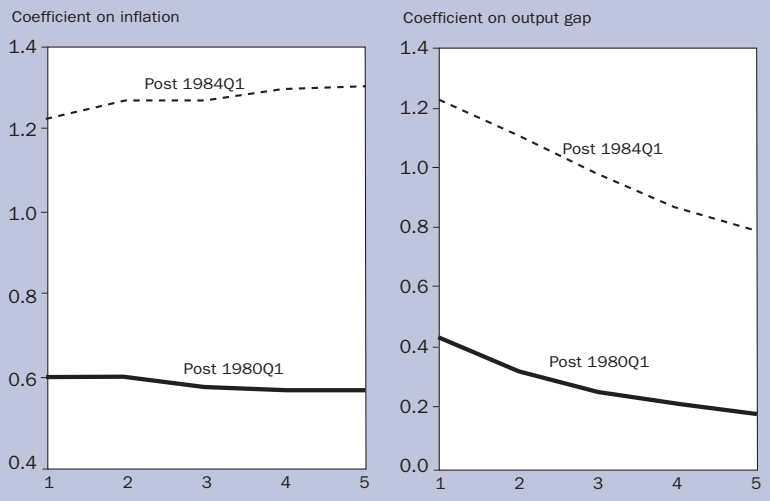
INTERNATIONAL COMPARISONS OF THE TAYLOR RULE



Source: Cecchetti, Hooper, Kasman, Shoenholtz, Watson (2007)

FIGURE 9

THE TAYLOR RULE AND TERM STRUCTURE OF INTEREST RATES



Source: Smith and Taylor (2007)

real GDP on long term interest rates of all maturities increased significantly. The shift occurred in the early 1980s and apparently had no previous explanation. However, there is a direct link between these coefficients of the central bank's monetary policy rule for the short-term interest rate.

There are two countervailing forces: the larger response of interest rates to these two macro variables and their reduced persistence due to the larger response. Using the link, one can see that the former dominates, thereby showing that the shift in the policy rule for the short-term interest rate in the early 1980s, which I mentioned earlier, provides an explanation for the puzzling shift in the long-term responses.

This approach also explains the "conundrum" in which policy rate increases in the 2004-2005 period had little effect on long term rates. In this case, a model of shifts in policy rules is needed for a complete explanation (Davig and Leeper, 2007).

8. Explaining and Assessing Deviations from Policy Rules: 1998 and 2003-05

The increased focus on monetary policy rules has led monetary economists to focus more on deviations from rules. I believe this is because there is less debate about the periods when the central banks are on the policy rules, which must be interpreted as a real success for the policy rule approach.

In their review of the Greenspan period, Blinder and Reis (2006), for example, focus mainly on the deviations from a Taylor rule in assessing the Greenspan era. In commenting on that paper at the Jackson Hole conference where it was delivered, I argued that following the principles imbedded in such a rule is why the Greenspan policy was so successful.

In any case, as mentioned at the start of this lecture, there are a few periods where there have been sizable deviations from the typical policy rule. By far the largest in the United States was during the period from 2003 to 2005, when the federal funds rate was well below what the experience of the Great Moderation would have predicted. This deviation is quite evident in Figure 3, which was the biggest deviation shown, comparable to the turbulent 1970s in Figure 2.

The rationale for this period of prolonged low interest rates was that it was needed to ward off deflation, but the low rates were also a factor in the eventual housing boom and bust. Similarly, there was a deviation in 1998 and 1999, which may have been a factor in the boom and bust in asset prices in 1999 and 2000. In any case, it is now possible to go back and assess such deviations and learn lessons for the future about their advisability. As such episodes are being reviewed, I see the disadvantages becoming more apparent compared to the advantages perceived at the time. If this trend continues, then the rationale for large deviations from monetary policy rules will diminish. This will increase the likelihood of staying with systematic,

predictable, rules-based policy that has worked well for most of the Great Moderation period. The short-term interest rate would then adjust mainly according to the major developments in the macro economy: inflation and real GDP.

Staying close to policy guidelines will also avoid moral hazard and show that there is no "put" in which the central bank bails out individual investors. If investors understand and believe that policy responds mainly to macroeconomic variables, then they will know that the central bank will not help them out if their risky investments fail.

9. Conclusion

In this lecture, I have focused mainly on the "scientific," as distinct from the "policy," contributions of monetary policy rules. In other words, I have tried to look for predictions, explanations, or better understandings of macroeconomic and financial phenomenon that monetary policy rules have brought. And I think I have found quite a few. The scientific contribution of an idea is measured by how much it helps us understand areas beyond the original idea. The more you get out of an idea compared to what you put into it, the bigger is the contribution. Of course, we live in a fluid economic world, and we do not know how long these explanations or predictions will last. I have no doubt that in the future—and maybe the not so distant future—a bright economist—maybe one right in this room—will show that some of the explanations discussed here are misleading, or simply wrong. But in the meantime, this is really a lot of fun. ■

REFERENCES

Ang, Andrew, Sen Dong, and Monika Piazzesi. 2005. "No Arbitrage Taylor Rules." Chicago Business School.

Bernanke, Ben. 2004. "The Great Moderation." Board of Governors of the Federal Reserve System.

Blinder, Alan and Ricardo Reis. 2006. "Understanding the Greenspan Standard." Jackson Hole Conference, Federal Reserve Bank of Kansas City.

Clarida, Richard and Daniel Waldman. 2007. "Is Bad News About Inflation Good News For the Exchange Rate?" Columbia University.

Davig, Troy and Eric M. Leeper (2007), "Generalizing the Taylor Principle," *American Economic Review*, 97(3):607 – 635.

Engel, Charles and Kenneth West. 2006. "Taylor Rules and the Deutsche-Dollar Real Exchange Rate." *Journal of Money Credit and Banking*. 38:1175-1194.

Engel, Charles, Nelson Mark, and Kenneth West. 2007. "Exchange Rate Models are Not as Bad as You Think." *NBER Macroeconomics Annual* 2007.

Fuhrer, Jeffrey. 1996. "Monetary Policy Shifts and Long-Term Interest Rates." *Quarterly Journal of Economics*. 111(4): 1183-1209.

Judd, John and Bharat Trehan. 1995. "Has the Fed Gotten Tougher on Inflation?" The FRBSF Weekly Letter, March 31, Federal Reserve Bank of San Francisco.

Patinkin, Don. 1965. *Money, Interest and Prices*. New York: Harper and Row.

Smith, Josephine M. and John B. Taylor. 2007. "The Link between the Long End and the Short End of Policy Rules." Stanford University.

Woodford, Michael. 2004. *Interest and Prices*. Princeton, NJ: Princeton University Press.