Fall Semester '04-'05
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Lecture 16: Simple Monetary Policy Rules in Theory

I. OVERVIEW

- In our discussion of the AD/IA model, we wrote down a monetary policy function that described the endogenous aspects of monetary policy. We used a particularly simple function which basically said that the Fed raised real interest rates when inflation went up and the Fed lowered real interest rates when inflation went down.
- The papers we discussed subsequently had several important lessons about the importance of having forward looking, transparent, independent central banks for the conduct of monetary policy and also talked about the rules vs. discretion debate, which emphasized the advantages of agents being able to "trust" the policymaker's future actions.
- Finally the discussion on inflation targeting emphasized the advantages of "constrained discretion": allowing policymakers flexibility in the short-run while providing a nominal anchor for policy in the intermediate to long-run.
- Building on these research advances, there has been a recent upsurge in interest in the topic of "simple monetary policy rules". Simple monetary policy rules are built on the idea that monetary policy should have a significant endogenous component. If policymaker's decisions are built around a simple policy rule, it will enhance the transparency of policymaker's actions.
- The key feature to remember is that a simple policy rule is not a "rule" in the Barro-Gordon sense. Policymakers are allowed to deviate from the rule if they desire. The best way to think of this topic is exactly the way we did in the AD/IA model: monetary policy has a strong endogenous component AS WELL AS an exogenous component. The simple monetary policy rule is a way of describing that endogenous component.
- Today's lecture will introduce you to the topic of simple monetary policy rules and examine a discussion paper by Kozicki that provides an overview of the topic.

II. INTRODUCTION TO SIMPLE MONETARY POLICY RULES

- What is a simple monetary policy rule? Well, it is basically an equation that relates movements in the Federal Funds rate to movements in a few common macroeconomic variables. The idea is that a well-founded monetary policy should react in an economically sensitive manner to movements in key macroeconomic variables and have relatively few unexplainable deviations. Therefore, even under discretion, a good monetary policy maker's behavior can be *mostly* captured by examining movements in key macroeconomic variables like inflation and unemployment.
- The last point is key: the study of simple monetary policy rules does not require the existence of a formal commitment mechanism that forces a monetary policy maker to follow a strict rule for setting policy. It merely captures the fact that, even under discretion, the majority of policy decisions may be well described using a simple policy rule.

- The recent interest in policy rules stems from a famous article by John Taylor in 1993, in which he described a simple formula for estimating the behavior of the Federal Reserve. The specific rule that he identified became widely known in academic and policy circles as the "Taylor Rule". Today, it is used as a reference point for policy discussions; most simple monetary policy rules are now known as "Taylor Rules" or "Taylor-type Rules" in the literature.

- The popularity for these simple monetary policy rules are two fold: first, they provide an economically intuitive, yet transparent, description of monetary policy that appeals to economists and policy makers; second, several studies have shown that variants of these simple "Taylor-type" rules have provided a good description of the behavior of the U.S. Fed under Greenspan, the Bundesbank and other developed-country central banks in recent times.

- Even when the rules do not accurately predict movements in policy, they serve as effective reference points for understanding the existing policy stance. In some sense, we can think of the policy rule as describing the normal behavior of the policy maker. When the policy variable diverges from that predicted by the policy rule, one can then search for the underlying reasons of that deviation: example include: the lowering of rates following the East Asian crisis in 1997, the raising of rates in the face of relatively low inflation in 1999 and 2000 and the lowering of rates in the face of the stock market crash of 1987.

The Taylor Rule

- The original Taylor Rule described a relationship between the Federal Funds rate, the current output gap and the current rate of inflation. It was presented in a number of different formats, all of which have the same interpretation. The two most well-known versions (equivalent to each other) are

$$\begin{aligned} i_t^* &= 4\% + 1.5(\pi_t - 2\%) + 0.5(y_t - y_t^*) \\ r_t^* &= 2\% + 0.5(\pi_t - 2\%) + 0.5(y_t - y_t^*) \end{aligned}$$

  where i^* is the targeted nominal Fed Funds rate, r^* is the targeted real Fed Funds rate defined as $i = r - \pi$, y is the log of Real GDP and y^* is the log of potential GDP, thus $y - y^*$ is the output gap, i.e. the percent deviation of output from steady state output. [Note that the actual Fed Funds rate i_t can deviate from the value described by the simple policy rule i_t^*, there is no binding constraint on the policy maker to follow this rule]

- In the above equation, Taylor described the behavior of the Fed as follows. He assumes that the desired rate of inflation is 2% a year and the equilibrium real interest rate in the economy is around 2% a year as well. The Fed sets the nominal Fed Funds rate to be around 4% a year if everything else was normal (i.e. no output gap and inflation was at the targeted value); this could equivalently be interpreted as the Fed shooting for a real Fed Funds rate of 2% a year if everything else was normal.

- The Fed funds rate would be raised when either inflation or the output gap increased, and the Funds rate would be lowered when either inflation or the output gap decreased. This is similar to the behavior we described when we laid out the foundations of the AD/IA model early on in the class. Taylor assumed that the nominal Fed funds rate would be raised by 50 basis points (0.5 percentage points) for every 1 percentage point increase in the output gap and by 150 basis points (1.5 percentage points) for every 1 percentage point increase in inflation.

- Once again the analysis could be done in terms of the real Fed Funds rate in which case the Fed would raise the real funds rate (by manipulating the nominal funds rate) by 50 basis points (0.5 percentage points) for every 1 percentage point increase in the output gap and by 50 basis points for every 1 percentage point increase in inflation [Note that a 150 basis point increase of the nominal funds rate in response to a 1 percentage point increase in inflation, effectively works out to be a 50 basis point increase of the real funds rate in response to a 1 percentage point rise in inflation.]

- Since Taylor's original paper, researchers have modified this type of policy rule and examined the performance of many different "Taylor-type" rules. In general, a Taylor-type rule can be described by an equation of the form

$$\begin{aligned} i_t^* &= \bar{r} + \bar{\pi} + \gamma_\pi(\pi_t - \bar{\pi}) + \gamma_y(y_t - y_t^*) \\ r_t^* &= \bar{r} + (\gamma_\pi - 1)(\pi_t - \bar{\pi}) + \gamma_y(y_t - y_t^*) \end{aligned}$$

  where $\bar{r}$ is the equilibrium real interest rate, $\bar{\pi}$ is the targeted inflation rate and y, y^* are the natural logs of output and potential output. γ_y is the "output reaction coefficient" and γ_π is the "inflation reaction coefficient": parameters that describe the magnitude of the response of the nominal funds rate to movements in the output gap and inflation.

- Typically, $\gamma_\pi > 1$: this captures the idea that the Fed would typically raise or lower the nominal Fed Funds rate by more than the change in inflation so as to affect the real funds rate (see Question 1 on your midterm exam). So you can think of Taylor-type rules as either describing the behavior of the targeted nominal Fed Funds rate as a function of equilibrium nominal rate (the sum of the inflation target and the equilibrium real interest rate), the output gap and deviations of inflation from target; alternatively, you can think of it as describing the behavior of the targeted real Fed Funds rate as a function of the equilibrium real interest rate, the output gap and deviations of inflation from target.

- In the next few lectures, we will look at many papers that look at Taylor type rules in more detail. Applications include trying to estimate Taylor-type rules for the actual behavior of the Fed, testing to see how a particular policy rule describes the behavior of the Fed, examining alternative variables that could be added to such rules, examining the performance of different policy rule using macroeconomic models to look at alternative policy choices etc.

- We will begin with a study of a paper by Sharon Kozicki of the Kansas City Fed. This paper provides a nice overview of simple policy rules and addresses important issues such as the timing of the variables, the measures of inflation and the output gap and how well these rules match or describe the behavior of the Fed in the period 1983 to date.

III. THE KOZICKI PAPER ON SIMPLE MONETARY POLICY RULES

- The basic motivation of the Kozicki paper is to understand the usefulness of Taylor Rules both for analysts trying to understand monetary policy decisions and for policy makers trying to understand how to conduct monetary policy. Since this article is published as an internal Federal Reserve research paper, it turns out to be more informative than the average economic research paper and therefore serves as a useful introduction to the topic.

- The flip side is that since it is not an academic article, there is no specific research question. If pressed, one would have to say that the specific research question is to assess how useful Taylor-type rules are to monetary policy makers in forming policy decisions. Kozicki finds that the usefulness of policy rules in helping to form what she calls "real time" policy decisions is limited but that Taylor rules are helpful to policy makers in identifying the general stance of monetary policy (i.e. should we be lowering or raising rates?) and in providing a reference point for analyzing the soundness of policy decisions.

Issues with Taylor-type Rules

- Kozicki raises three primary problems that researchers working with Taylor rules have to deal with:

  1. Timing
  2. Reaction Coefficients on Inflation and Output.
  3. Reaction to other variables.

  Each of these issues will be discussed below.

- **Timing** The basic Taylor rule, and most Taylor type rules, assume that the Fed Funds rate for the current period (the period is usually a quarter) is set according to the output gap and the deviation of inflation from target in the current quarter: in other words interest rates react contemporaneously to movements in inflation and the output gap. Kozicki points out that this may not be a realistic assumption since GDP data is only published with a lag, so it is at least a quarter late. Therefore the appropriate policy rule may have lagged macroeconomic variables rather than contemporaneous variables on the RHS.

- Furthermore the data is revised at the end of the year resulting in a different value for GDP than in the quarter released. This poses a problem for researchers and policy makers: policy makers may not have access to the appropriate current quarter data in forming their policy decisions; researchers describing the behavior of policy makers will use revised data that may not reflect the data that the Fed had when they made their decision. In other words, behavior that seems unusual given the revised data, may not be unpredictable if viewed within the context of the unrevised data.

- **Magnitude of Reaction Coefficients** Taylor suggested weights of 0.5 and 1.5 on inflation and the output gap, however this is far from being a consensus. There have been several studies that find that theoretically, higher weights on the output gap (closer to 1) and inflation (closer to 2) yield better performance.

- Furthermore, estimating reaction functions for the Fed yield different estimates from the 0.5 and 1.5 found by Taylor once we change the sample period. The only result that seems to hold true across theoretical studies is that the reaction coefficient on inflation should be greater than 1: essentially, the Fed should raise nominal interest rates by more than the increase in inflation in order to bring up real interest rates.

- **Reaction to Other Variables** There has also been disagreement on what variables should be included in a simple monetary policy rule in the first place. Kozicki makes a strong argument for including last period's interest rate as an right hand side variable: basically the Fed tends to be very cautious in moving interest rates at any given point, and even if economic conditions change dramatically, they may only make small rate changes.

- Other variables that have been bandied about include exchange rates, the value of the stock market, etc.

- A related problem is deciding which of the competing measures to use, even when we can all agree on what variable should go on the right hand side. For example, the literature has reached a consensus that inflation and the output gap belong on the RHS of the policy rule. However, it is not immediately clear what measure of inflation should go there: CPI, core CPI, GDP deflator etc. Nor is it immediately clear how to measure potential output: do we use a linear trend, a split linear trend etc.

- These are all issues that Kozicki raises in her study of whether the Taylor Rule is informative to policy makers in forming policy decisions. She breaks her analysis into two sections: are the recommendations from Taylor Rules robust? And are recommendations from Taylor Rule useful?

Robustness of Simple Policy Rules

- The robustness analysis focuses on the range of different recommendations that one gets from a Taylor Rule depending on what measures one uses for the macroeconomic variables. Chart 1 summarizes the values of the four different measures of inflation and Chart 2 summarizes the values of the 6 different output gap measures that Kozicki uses.

- Chart 3 tracks the range of predicted values of the different rules, along with a specific graph of the original Taylor Rule with reaction coefficients of 0.5 and 1.5, and the actual Fed Funds rate. The funds rate falls within the predicted range for the period 1987-1998 (with a few minor exceptions in the early 1990s). It does a decent job in 1985 and 1986 but does less well in the early 1980s.

- The Taylor Rule itself does a stellar job between 1987 and 1991 but has done less well since then. Interestingly, the original Taylor paper describing the predictability of the Fed circulated around the time that Fed policy began to diverge from the Taylor Rule: some people form their own conspiracy theories about the behavior of the Fed as a result!

- Charts 4 and 5, examine the "robustness" of the Taylor Rule to different measures of inflation and the output gap individually. Basically Chart 4 uses the GDP deflator to measure the inflation rate in the economy and examines the range of values that one would get for different inflation rates. Chart 5, on the other hand, picks a single measure of the output gap and examines the range of recommended values for the funds rate based on different measures of inflation. The gist of the results remain: the policy rule works well for 1987-1992, less well since then or before then.

- Kozicki also looks at the robustness of results to changes in the "weights", the reaction coefficients in the policy rule. She basically tries out 4 different combinations where she has a reaction coefficient of either 0.5 or 1.0 on the output gap and 1.5 or 2.0 on inflation [Note: Kozicki talks about the reaction coefficients assuming that the real interest rate is on the LHS. So her reaction coefficients for inflation are 0.5 or 1.0, which correspond to 1.5 or 2.0 if you keep the nominal rate on the LHS (See the early part of this lecture notes for a discussion on γ_π]

- Table 2 summarizes the results of this exercise: she shows that the recommended value for the Fed funds rate varies on average between 1.14 to 2.15 with the changes in reaction coefficients

depending on what measure of inflation and output gap are used. I personally do not find this section to be informative: her robustness measures are somewhat weird: if different measures of inflation are wildly different from one another, it is hardly surprising that the policy rule gives a wide range of predictions: the blame for that can hardly be laid on the "non-robustness" of the policy rule.

Usefulness of Simple Policy Rules

- Finally, Kozicki presents the central thesis of the paper: How well does the policy rule capture the decisions of the policy makers in the past? In order to assess this, Kozicki estimates reaction coefficients econometrically using data from the period 1983-1998. The results are presented graphically in Chart 6, and numerically in Table 3. The coefficients numerically differ from the values in the Taylor rule but statistically can't be differentiated.

- The predictions of this model follow the basic pattern of the previous results: the period before 1987 and 1991 are not very good fits, even though the last few years of her study (1995-1997) are not wildly off. So the most favorable interpretation is that a simple policy rules provides a good first pass at estimating movements in the Fed Funds rate, except for the period before 1985 and in general provides a decent description of movements in the funds rate if not quite able to track the level of the funds rate.

- Kozicki runs a final set of studies where she adds an interest rate smoothing term to the policy rule. This means a policy rule of the form $i_t^* = \rho i_{t-1} + (1-\rho)\left[\bar{r} + \bar{\pi} + \gamma_\pi(\pi_t - \bar{\pi}) + \gamma_y(y_t - y_t^*)\right]$ where ρ is the degree of smoothing in the economy. So a high value of $\rho \approx 1$ indicates a policy maker who is relatively cautious about adjusting interest rates while a low value of $\rho \approx 0$ indicates a policy maker who is relatively more likely to adjust interest rates

- Kozicki then estimates policy rules of the above form to see if they improve the fit. She finds that econometric estimates of the degree of smoothing differ significantly from 0, indicating that central banks do tend to move cautiously and that the current interest rate in the economy is very closely related to last period's interest rate. She finds that estimates of the reaction coefficients on inflation and output are now very close to the 1.5 and 0.5 values used in Taylor's original rule. These results are presented numerically in Table 5 and graphically in Chart 6. The policy rule with smoothing does better than the rule without smoothing although it still does not well pre-1985 and in the period 1992-1994.

- Finally Kozicki provides some evidence that the Fed often reacts to other variables in forming policy decisions: the stock market, international economic turbulence etc. She interprets this evidence as being a strike against the usefulness of Taylor Rules because they do not capture the decision making of the Federal Reserve.

- However, I tend to be a little more optimistic than Kozicki about the usefulness of simple monetary policy rules. Kozicki does provide evidence showing that the Taylor rule or variants of it are not always able to predict the behavior of the Fed Funds rate over the last 17 years or so. However, the results are greatly improved if we restrict our focus to the Greenspan years (1987 onward).

- The simple policy rule also serves as a useful baseline for evaluating policy decisions. It is true that such a rule has not worked well in the late 1980s which then leads us to the interesting question of why policy may have deviated from this predictable rule. Furthermore, the fact

that the Fed occasionally reacts to other variables does not mean that the simple policy rule is any less useful: as we pointed out earlier, this policy rule is not binding on the Fed: we expect that in normal times the Fed would act accordingly and when the need arises, deviate from the rule with good reason.

- Overall, however, the paper provides us with a useful glimpse into simple policy rules, one that will serve us well when we tackle more complicated topics later on in the semester.