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Taylor Rule or optimal timeless policy? Reconsidering the Fed's behavior since 1982[☆]

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ABSTRACT

We compare three standard New Keynesian models differing only in their representations of monetary policy—the Optimal Timeless Rule, the original Taylor Rule and another with 'interest rate smoothing'—with the aim of testing which if any can match the data according to the method of indirect inference. We find that the Optimal Timeless Rule performs the best, either with calibrated parameters or with estimated parameters. This model can also account for the widespread finding of apparent 'Taylor Rules' and smoothed interest rates in the data, even though neither of these represents the true policy.

1. Introduction

In this paper our aim is to uncover the principles according to which the Board of Governors of the US Federal Reserve System (the Fed) has conducted monetary policy since the early 1980s. We do so in a novel way by asking which such principles can, when combined with a widely-accepted macro model, replicate the dynamic behavior of the US economy during the sample period. By 'principles' we mean either an explicit rule the Fed follows (such as an interest-rate setting rule) or some other economic relationship that it aims to ensure occurs (such as a fixed exchange rate or as here an optimality condition).

The main context for this work is the influential paper by Taylor (1993), who—building on earlier work by Henderson and McKibbin (1993a,b) which argued for the efficacy of interest rate rules—suggested that the Fed actually had been for some time systematically pursuing a particular interest rate rule, reacting directly to two 'gaps', one between inflation and its target rate, the other between output and its natural rate. Such a 'Taylor Rule' was subsequently adopted widely in New Keynesian models to represent the behavior of monetary policy (Rotemberg and Woodford, 1997, 1998; Clarida et al., 1999, 2000; Rudebusch, 2002; English et al., 2003).

However, Minford et al. (2002) and Cochrane (2011) have shown that a Taylor Rule is not identified when considered as a single equation relationship. Estimates of such a 'rule' may emerge from the data when the Fed is following quite other monetary policies; this is because a variety of relationships within the economy can imply a relationship between interest rate, inflation and the output gap which mimics a Taylor Rule. In the presence of such an identification problem, direct estimation of Taylor Rules on the data does not establish whether the Fed was actually pursuing them or not. Some other way of testing hypotheses about monetary policy must be found which makes use of identifying restrictions from a fully specified model. The one proposed here is to set up competing structural models which differ solely according to the monetary policies being followed, and to distinguish between these models according to their ability to replicate the dynamic behavior of the data. Thus for example if one were to fail to reject just one of these models and reject the rest, it would be reasonable to argue that this model succeeds because in it not only the rest of the economy but also monetary policy is well-specified. Of course other less decisive empirical outcomes of the tests are entirely possible.

The rest of this paper is organized as follows: Section 2 reviews the work estimating monetary policy rules and makes a critique of it in terms of identification; Section 3 outlines the model and the rules we propose to test; Section 4 explains our methodology and sets out our

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finding that the Fed pursued an optimal timeless policy; Section 5 reveals how this can explain the apparent 'Taylor Rules' the data would display; in Section 6 we extend these discussions to allow for full evaluation of the models basing on their best numerical versions; Section 7 concludes.

2. Taylor Rules, estimation and identification

Taylor (1993) suggested that a good rule for monetary policy would set the Federal Funds rate according to the following equation:

$$i_t^A = \pi_t^A + 0.5x_t + 0.5\left(\pi_t^A - \pi^*\right) + g \tag{1}$$

where x_t is for the percentage deviation of real GDP from trend, i_t^A is the annual rate of inflation averaged over the past four quarters, with inflation target π^* and real GDP growth rate g both set at 2%.

Known as the original 'Taylor Rule', Eq. (1) was found to have predicted the movement of actual Fed rates well for much of the period from 1987 until the banking crisis of the late 2000s. This success convinced many economists that the Fed's policy at the time could be conveniently described by this equation. Thus a number of variants have also been proposed; for example, Clarida et al. (1999) suggested a rule that allows for policy inertia can take the form:

$$i_t^A = (1-\rho)\left[\alpha + \gamma_\pi\left(\pi_t^A - \pi^*\right) + \gamma_x x_t\right] + \rho i_{t-1}^A \tag{2}$$

with ρ showing the degree of 'interest rate smoothing'. Others have included lags or leads of the inflation and output gap terms to account for backward-looking or forward-looking behaviors—this includes Rotemberg and Woodford (1997, 1998) and Clarida et al. (2000).

Thus many have attempted to estimate these rules in order to uncover the underlying policy rule. A common practice of this is to estimate it as a single-equation regression (as in Rotemberg and Woodford, and Clarida, Gali and Gertler just cited).[2] Others (such as Smets and Wouters, 2007 and Ireland, 2007) have taken the alternative approach of including and estimating it in a full DSGE model; we consider this alternative below. Many have claimed that a Taylor Rule fitted the data well. However, while econometricians have to deal with the usual difficulties encountered in estimating a Taylor-type equation (e.g., Carare and Tchaidze, 2005 and Castelnuovo, 2003), Minford et al. (2002) and Cochrane (2011) have pointed out that single equation estimates face an identification problem—see also Minford (2008) which we use in what follows.

Lack of identification occurs when an equation could be confused with a linear combination of other equations in the model. In the case of the Taylor Rule, DSGE models give rise to the same correlations between interest rate and inflation as the Taylor Rule, even if the Fed is doing something quite different, such as targeting the money supply. For example, Minford et al. (2002) show this in a DSGE model with Fischer wage contracts (see also Gillman et al., 2007).

In effect, unless the econometrician knows from other sources of information that the central bank is pursuing a Taylor Rule, he cannot be sure he is estimating a Taylor Rule when he specifies a Taylor Rule equation because under other possible monetary policy rules a similar relationship to the Taylor Rule is implied.[3]

To illustrate the point, we may consider a popular DSGE model but with a money supply rule instead of a Taylor Rule:

$$\text{(IS curve)}: y_t = \gamma E_{t-1}y_{t+1} - \phi r_t + v_t$$

$$\text{(Phillips curve)}: \pi_t = \zeta\left(y_t - y^*\right) + \nu E_{t-1}\pi_{t+1} + (1-\nu)\pi_{t-1} + u_t$$

$$\text{(Money supply target)}: \Delta m_t = m + \mu_t$$

$$\text{(Money demand)}: m_t - p_t = \psi_1 E_{t-1}y_{t+1} - \psi_2 R_t + \varepsilon_t$$

$$\text{(Fisher identity)}: R_t = r_t + E_{t-1}\pi_{t+1}.$$

This model implies a Taylor-type relationship that looks like: $R_t = r^* + \pi^* + \gamma\chi^{-1}(\pi_t - \pi^*) + \psi_1\chi^{-1}(y_t - y^*) + w_t$, where $\chi = \psi_2\gamma - \psi_1\phi$, and the error term, w_t, is both correlated with inflation and output and autocorrelated; it contains the current money supply/demand and aggregate demand shocks and also various lagged values (the change in lagged expected future inflation, interest rate, the output gap, the money demand shock, and the aggregate demand shock). This particular Taylor-type relation was created with a combination of equations—the solution of the money demand and supply curves for interest rate, the Fisher identity and the IS curve for expected future output.[4] But other Taylor-type relations could be created with combinations of other equations, including the solution equations, generated by the model. They will all exhibit autocorrelation and contemporaneous correlation with output and inflation, clearly of different sorts depending on the combination used.

All the above apply to identifying a single equation being estimated; thus one cannot distinguish a Taylor Rule equation from the equations implied by the model and alternative rules when one just estimates that equation. One could attempt to apply further restrictions but such restrictions are hard to find. For example, one might restrict the error process of a Taylor Rule in some distinct way, say to being serially uncorrelated. But the error in a Taylor Rule, which represents 'monetary

[2] We include in 'single equation estimation' methods such as Instrumental Variables which deal with endogeneity but do not make use of the identifying restrictions from a full model. For example, the exogenous variables used as instruments would not be different across the same model with different monetary policy rules.

[3] While one may argue that various announcements, proposals and reports published by the central bank directly reveal to econometricians the bank's reaction function, it is worth noting that what the Fed actually does is not necessarily the same thing as what its officials and governors say it does. So these documents, while illuminating, can complement but cannot substitute for econometric evidence.

[4] From the money demand and money supply equations, $\psi_2\Delta R_t = \pi_t - m + \psi_1\Delta E_{t-1}y_{t+1} + \Delta\varepsilon_t - \mu_t$. Substitute for $E_{t-1}y_{t+1}$ from the IS curve and then inside that the real interest rate from the Fisher identity giving $\psi_2\Delta R_t = \pi_t - m + \psi_1\left(\frac{1}{\gamma}\right)\{\varphi(\Delta R_t - \Delta E_{t-1}\pi_{t+1}) + \Delta y_t - \Delta v_t\} + \Delta\varepsilon_t - \mu_t$; then, rearrange this as $\left(\psi_2 - \frac{\psi_1\varphi}{\gamma}\right)\Delta(R_t - R^*) = (\pi_t - m) - \frac{\psi_1\varphi}{\gamma}\Delta E_{t-1}\pi_{t+1} + \frac{\psi_1}{\gamma}\Delta(y_t - y^*) - \frac{\psi_1}{\gamma}\Delta v_t + \Delta\varepsilon_t - \mu_t$, where the constants R^* and y^* have been subtracted from R_t and y_t respectively, exploiting the fact that when differenced they disappear. Finally, $R_t = r^* + \pi^* + \gamma\chi^{-1}(\pi_t - \pi^*) + \psi_1\chi^{-1}(y_t - y^*) + \{(R_{t-1} - R^*) - \psi_1\varphi\chi^{-1}\Delta E_{t-1}\pi_{t+1} - \psi_1\chi^{-1}(y_{t-1} - y^*) - \psi_1\chi^{-1}\Delta v_t + \gamma\chi^{-1}\Delta\varepsilon_t - \gamma\chi^{-1}\mu_t\}$ where we have used the steady state property that $R^* = r^* + \pi^*$ and $m = \pi^*$. In effect we have found a linear combination of the equations of this model that mimics the Taylor Rule. In general we can write the model as $A(L)x_t = Bx^* + Dw_t$, where x, x^*, w are respectively the vectors of endogenous variables, constants and errors. $A(L)$ is the matrix of coefficients including those on lag and (expected) lead values. The general solution of this model will be a VARMA. One could also find linear combinations of the solution equations that would yield $R_t = R^* + q_1(y_t - y^*) + q_2(\pi_t - \pi^*) + \eta_t$, where η_t is an error term which includes lagged endogenous variables (as deviations from equilibrium) and current and lagged errors. Our purpose here is to illustrate that a widely-used model exists with a different monetary policy rule which could be confused with the Taylor Rule being estimated. It is possible that more complex models could generate sufficient identifying restrictions in single equation estimation; note however that large DSGE models with nominal rigidity can generally be reduced to the IS/Phillips-Curve/Monetary-policy form used here, with the error terms sweeping up expressions that do not fit the structure. While of course the errors in the linear combination of equations resembling the Taylor Rule will differ in principle from the error term in the Taylor Rule which represents ad hoc 'other' policy reactions to events, there is no obvious way of distinguishing them, since both contain endogenous variables and both are persistent.