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In-sample and out-of-sample properties of linear and nonlinear Taylor rules

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Abstract

This paper examines the in-sample and out-of-sample properties of linear and nonlinear Taylor rules using real-time US data. We find that: (i) in-sample and out-of-sample performance measures generally select the same functional form for the Taylor rule and that (ii) the form of the Taylor rule differs across the pre-Greenspan and Greenspan sample periods. However, when we compare the out-of-sample forecasting performance of the Taylor rules to those of univariate models of the federal funds rate, we find it quite interesting that the univariate models forecast better than the Taylor rules after, but not before, 1979.

JEL classification: C22; E17; E43

Keywords: Nonlinear monetary rule; Out-of-sample forecasts; Linear Taylor rule; Nonlinear Taylor rule

1. Introduction

Taylor's (1993) celebrated work shows that a simple rule, in which the short-term nominal interest rate reacts linearly to deviations of inflation and output from their target levels, provides a good description of actual monetary policy in the United States. The importance of a simple characterization of the conduct of Federal Reserve policy is evi-

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denced by the fact that, at the time of this writing, Econlit lists 151 papers with the phrase "Taylor rule" in the title and/or abstract. The original specification of the rule took the form:

$$i_t^* = r^* + \pi_t + \beta_\pi(\pi_t - \pi^*) + \beta_y y_t, \tag{1}$$

where i_t^* is the target short-term nominal interest rate for quarter t, r^* is the equilibrium real interest rate, π_t is the inflation rate, π^* is the inflation target, and y_t is the output gap measured by the deviation of real output from its potential level.

When π^* and r^* were set equal to two and β_π and β_y were set equal to one half, Taylor (1993) found that Eq. (1) provided a good description of the behavior of the federal funds rate over the 1987–1992 period. He also claimed that this rule could be a useful guideline for future monetary policy.

Many subsequent papers have been written with the aim of obtaining the most appropriate form of the Taylor rule. Clarida et al. (1998, 2000), Woodford (1999), Goodhart (1999), Levin et al. (1999), and Amato and Laubach (1999) generalized Eq. (1) to allow for lagged values of the federal funds rate. The lags were statistically significant, purged all serial correlation from the residuals, and provided evidence that the Federal Reserve acts to smooth the time path of interest rates. Huang et al. (2001) and Orphanides (2003) showed that a forward-looking rule performed better than a backward-looking rule and that a forward-looking rule was a good indicator of ensuing monetary policy. Levin et al. (1999) and Taylor (1999) found that the rule was robust in that it performed well in a number of different macroeconomic settings.

More recently, it has been argued that a nonlinear specification for the Taylor rule might be more appropriate than a linear one. Nobay and Peel (2003), Cukierman and Gerlach (2003), Gerlach (2003), Ruge-Murcia (2002, 2004), Bec et al. (2002), Dolado et al. (2002) and Surico (2004) argue that central bank preferences are not symmetric in inflation and/or the output gap. If, for example, the Fed is more concerned about high inflation than low inflation, the response of i_t^* is likely to be more dramatic when inflation is above the target than when inflation is below the target. As a result, the optimal feedback rule will not be linear in π_t. Schaling (1999) and Dolado et al. (2005) provide a second rationale for a nonlinear Taylor rule. If the aggregate supply curve is convex, so that there is a nonlinear relationship between output and inflation, the optimal feedback rule relating interest rates to output and inflation should also be nonlinear. They estimate several nonlinear feedback rules and conclude that nonlinear rules fit the data better than linear ones.

Given the proliferation of Taylor rules, it is not clear which one provides the best model of the federal funds rate. As such, one aim of the paper is to compare the in-sample and the out-of-sample properties of linear and nonlinear Taylor rules using real-time US data. Although the in-sample performance of the alternative Taylor rule specifications is important, there is a large literature – see Clements and Hendry's (1998) excellent survey – indicating that out-of-sample forecasting performance can be a useful aid in selecting among alternative functional forms. As illustrated by Swanson and White (1997), Rothman (1998), and Lui and Enders (2003), out-of-sample forecasts can be especially useful for model selection when working with nonlinear models because of the enhanced possibilities for overfitting the data.

A second aim of the paper is to provide a comprehensive look of the in-sample properties of the policy rules using real-time data. To our knowledge, previous studies on nonlinear Taylor rules employ only *ex-post* data. However, as pointed out by Orphanides