Journal of Macroeconomics 43 (2015) 205–215

Contents lists available at ScienceDirect

Journal of Macroeconomics

journal homepage: www.elsevier.com/locate/jmacro

Time variation in U.S. monetary policy and credit spreads

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ARTICLE INFO

Article history:
Received 10 March 2014
Accepted 29 November 2014
Available online 17 December 2014

JEL codes:
C11
E52
E58

Keywords:
Switching Taylor Rule
MCMC
Zero lower bound
Credit spreads

ABSTRACT

Through the lens of the Taylor rule, this paper is concerned with the circumstances in which the Fed would change its behavior. A Bayesian MCMC method is proposed to deal with a switching Taylor rule robust to zero lower bound and heteroscedasticity. The posterior results from Markov-switching Taylor rule indicate that, first, there is strong evidence for an "active" regime in which the Fed responses to output gap aggressively. Second, the movements in the posterior probability of the active regime is highly correlated with credit spreads. I then use a switching Taylor rule with transition probabilities connected to credit spreads to show that the positive correlation is strongly supported by data, implying that the Fed responses to output gap more strongly when the credit spreads rise.

1. Introduction

Linking movements in the Federal Funds rate to a set of macroeconomic variables by a policy rule helps economists and the general public understand how the central bank conducts monetary policy. Since Taylor (1993) proposed a hypothetical monetary policy rule, referred to as the Taylor rule, over two decades ago, there has been burgeoning research on the changing behaviors of the central bank. Many empirical studies, e.g., Coibion and Gorodnichenko (2011) and Bianchi (2013), have shown noteworthy instability in the parameters of the Taylor rule. This paper is concerned with the following question: In what circumstances would the central bank change its behaviors? In other words, is there an indicator, which contains important information about the economic condition, that might affect the Fed's responses to targeting variables?

Without officially committing to following a specific rule, the Fed's decisions on adjusting the Funds rate may be affected by the information it obtains by reading a set of macroeconomic indicators. For example, Gilchrist and Zakrajšek (2012) point out that credit spreads have been thought to contain important signals regarding the evolution of the real economy and the risks to the economic outlook. A rise in the credit spread might reflect shifts in the effective supply of funds offered by financial intermediaries, leading to a subsequent reduction in spending and production. From the Fed's point of view, if it is confronted with weak economic activity and rising credit spreads, aggressively adjusting the Funds rate can provide sufficient funds for firms in need, preventing further contractions caused by massive defaults. On the other hand, when the financial market is functioning well, a relatively moderate adjustment of the Funds rate might be enough to boost the real economic activity through the usual transition mechanisms of monetary policy.

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http://dx.doi.org/10.1016/j.jmacro.2014.11.005
0164-0704/

The fundamental empirical framework of this paper is based on a version of switching coefficients Taylor rule, which is built upon the following prototype Taylor rule:

$$i_t = \alpha_0 + \alpha_\pi(\pi_t - \pi^*) + \alpha_{x,t}x_t, \tag{1}$$

where i_t is the short-run nominal interest rate, π_t is inflation and x_t is output gap. However, several empirical issues brought up by the properties of U.S. post-WWII data need to be addressed carefully. The first issue concerns the inflation target, π^*. Due to the fact that the inflation target defines the inflation gap, an abrupt change in the inflation target can be at least partially offset by a corresponding change in the response coefficient, α_π, or vice versa. Therefore, to detect switches in response coefficients, it is inappropriate to assume a constant inflation target for samples spanning several decades. The second issue is that, since 2009, the Federal Funds rate has stayed at the "zero lower bound", which prevented the Fed from lowering the short-run interest rate any further in response to the severe recession after the financial crisis of 2008. The zero lower bound causes problems similar to the censored dependent variable, leading to biased estimates of the response coefficients. The third issue is that the Federal Funds rate is heteroscedastic. According to Sims and Zha (2006), failure to allow for heteroscedasticity properly can strongly bias statistical evidence in favor of significant shifts in response coefficients describing monetary policy. Furthermore, even when heteroscedasticity is taken into account, it may be problematic if the coefficients in the Markov-switching Taylor rule are assumed to switch simultaneously with the volatility in shocks.

To deal with these issues, I follow Cogley and Sbordone (2008) and approximate the inflation target as the level to which inflation is expected to settle after short-run fluctuations die out. The zero lower bound can be easily dealt with using a Tobit specification to connect the actual and latent Funds rate. Finally, I use a stochastic volatility process as per Kim et al. (1998) to take account for heteroscedasticity. Even though the estimation method based on likelihood is feasible, there is a difficulty that has to be overcome along the way. The objective of this paper requires conducting a hypothesis testing on regime switches in coefficients of the Taylor rule. It is a challenging task within a frequentist framework in that some nuisance parameters are not identified under the null hypothesis of no regime switch. This task will be complicated further if heteroscedasticity is taken into account. Therefore, this paper proposes a Bayesian method to deal with all three of these issues at once, and to conduct the model comparison or selection simply via the Bayes factor.

I first use a purely probabilistic tool, he Markov-switching process, to investigate *when* the Fed has changed its behavior. The posterior results show very strong evidence for regime switches in the Taylor rule: In the "active" regime, the Fed reacts to the *output gap* more strongly than it does in another regime. On the other hand, the Bayesian model comparison does not support the hypothesis that the Fed's responses to inflation gap in two regimes are different.

Probing deeper into the timing of regime switches from Markov-switching Taylor rule, I find that the probability of active regime remarkably coincides with the movements of credit spreads, measured by the difference between Moody's Aaa and Baa corporate bond yields. Thus I specify and estimate a switching Taylor rule with transition probabilities of regimes being a function of the corporate bond credit spreads. The posterior results indicate that credit spreads have strong and positive correlation with the probability of the active regimes.

The outline of the remainder of the paper is as follows. Section 2 introduces the empirical framework. In Section 3, I present the procedure for estimating and comparing models under consideration. I discuss the empirical results in Section 4. Section 5 is the conclusion.

2. The Taylor rule and regime switches

2.1. The Markov-switching Taylor rule

The Taylor rule assumes that short-run nominal interest rate responds contemporaneously to the overall slack in the real economy and also to inflation. Let $\hat{i}_t$ denote the Fed's target rate for the Federal Funds rate in period t:

$$\hat{i}_t = \alpha_0 + \alpha_\pi[\pi_t - \pi^*] + \alpha_x x_t, \tag{2}$$

where π^* is the long-run inflation target, so α_0, by construction, is the desired nominal interest rate when the inflation gap is closed and the real economy is operating on its potential level. I follow Clarida et al. (2000) and assume that $\alpha_0 = rr + \pi^*$, and rr is the neutral, or equilibrium, real interest rate, which is determined by non-monetary factors in the long run.

It is straightforward to specify a Markov-switching coefficient Taylor rule by allowing the response coefficients in Eq. (2) to vary over time as follows:

$$\hat{i}_t = rr + \pi^* + \alpha_\pi(s_{c,t})[\pi_t - \pi^*] + \alpha_x(s_{c,t})x_t, \tag{3}$$

where $\alpha_\pi(s_{c,t})$ and $\alpha_x(s_{c,t})$ evolve according to Eq. (4). $S_{c,t}$ is an unobserved two-state Markov-switching variable that evolves according to the transition probabilities given below:

$$\begin{aligned}
&Pr[s_{c,t} = 1 | s_{c,t-1} = 1] = p_{c,11},\\
&Pr[s_{c,t} = 0 | s_{c,t-1} = 1] = 1 - p_{c,11},\\
&Pr[s_{c,t} = 0 | s_{c,t-1} = 0] = p_{c,00},\\
&Pr[s_{c,t} = 1 | s_{c,t-1} = 0] = 1 - p_{c,00},
\end{aligned}$$