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The effects of the monetary policy regime shift to inflation targeting on the real interest rate in the United Kingdom

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ABSTRACT

This paper studies the effects of the monetary policy regime shift to inflation targeting on the stochastic properties of the real interest rate in the U.K. The empirical analysis suggests a constant mean of the real interest rate that shifts with the monetary policy regime change to inflation targeting in October 1992. The mean-reverting level of the real interest rate has decreased from 5.1% to 2.3% per annum with the change in monetary policy to inflation targeting. In addition, the shift in monetary policy regime to inflation targeting has reduced the volatility of the real interest rate and increased the persistence of real interest rate deviations from the mean. The results suggest that the central bank can affect the stochastic properties of the real interest rate through the choice of monetary policy regime over a long period of time.

1. Introduction

The behaviour of real interest rates has important implications for many issues in economics and finance. However, little consensus exists about the factors that affect the real interest rate. Fama's (1975) famous claim that the real interest rate is a constant has led to a debate on whether the choice of monetary policy regime affects the real interest rate. A policy-invariant real interest rate would be problematic for many macroeconomic models, because the principal real effect of monetary policy runs through a link between policy and real interest rates. In a series of articles a stationary series with infrequent shifts in the mean describes the real interest rate (e.g., Garcia and Perron, 1996; Bai and Perron, 2003). Further research into the reasons behind these real rate shifts suggests a link between inflation regime changes and real interest rate shifts (e.g., Rapach and Wohar, 2005). Moreover, Caporale and Grier (2005) find that changes in the Fed Chair affect the mean of the real interest rate when they control for shifts in the inflation regime.

This paper studies the effects of the British monetary policy regime shift to inflation targeting on the real interest rate. British monetary policy was determined by the exchange-rate peg of the European Exchange Rate Mechanism (ERM) before inflation targeting. During the run-up to membership in the ERM and the brief period of participation in the ERM the monetary policy goal was a stable exchange rate with other European countries. On Black Wednesday, 16 September 1992, the British government was forced to withdraw from the ERM after they could not keep sterling above its agreed lower limit to a basket of other European currencies. This nonvoluntary departure from the ERM on Black Wednesday has sparked a rapid and unanticipated monetary policy regime shift in the U.K. The exchange rate targeting policy of the ERM period was replaced by an explicit inflation targeting policy. In October 1992 the British government established an official target rate for U.K. inflation.[1] Mishkin (1999) suggests that monetary policy regime changes are usually implemented gradually. This protects the reputation of the central bank. Therefore, the abrupt and official shift in British monetary

[1] A quantitative target for inflation is a central element of an inflation targeting policy. In the U.K. the initial inflation target band of 1% to 4% inflation (with a midpoint of 2.5% per annum) was reformulated to an explicit medium-term point target of 2.5% per annum in June 1995. In the process of granting operational independence to the Bank of England from the Treasury in May 1997, the Chancellor announced a symmetric inflation point target of 2.5% at all times with equal weight to above and below target inflation. The Chancellor has exercised the right to change the monetary policy target when the inflation target rate was reduced from 2.5% to 2% per annum in December 2003. This has brought the British target for inflation in line with the 2% inflation target of the European Central Bank for the countries in the Euro Area.

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policy to inflation targeting offers an opportunity to study the question whether the choice of monetary policy regime affects the real interest rate.

We use a continuous-time interest rate model to study the behaviour of the real interest rate. The mean-reverting level of the real interest rate follows the time-varying mean structure of Balduzzi et al. (1998). In addition, we implement a structural break in the model parameters with the British monetary policy regime shift to inflation targeting to measure the effects of the monetary policy regime shift on the real interest rate. This empirical model encompasses as special cases (i) a constant mean-reverting level that shifts with the monetary policy regime change to inflation targeting and (ii) a constant mean-reverting level that is unaffected by the monetary policy regime shift. The model separates the impact of the monetary policy regime shift on the mean-reverting level from unrelated movements in the mean of the short rate. The empirical results reveal a statistically significant variation of the mean-reverting level of the real short rate that results from the monetary policy regime shift to inflation targeting. The mean of the real interest rate is a constant that shifts with the change in monetary policy regime. The monetary policy regime shift to inflation targeting leads to a persistent change in the stochastic properties of the real interest rate, because it lowers the mean of the real interest rate, reduces the volatility of the real interest rate and increases the persistence of real interest rate deviations from the mean of the real interest rate.

The remainder of the paper is organized as follows. Section 2 outlines the empirical model of the real interest rate in the U.K. Section 3 discusses the data and estimation of the continuous-time interest rate model from discretely sampled data. Section 4 presents the empirical results. Section 5 summarizes the results and conclusions.

2. Empirical model

We model the short-term real interest rate with a continuous-time interest rate model. Let r_t denote the instantaneous real interest rate at time t. The following continuous-time process describes the behaviour of the real short rate

$$dr_t = \phi_t(\mu_t - r_t)dt + \sqrt{\sigma_{0,t}^2 + \sigma_{1,t}^2 r_t}dW_t \tag{1}$$

where μ_t is the time-varying mean-reverting level of the short rate at time t and W_t is a standard Brownian motion or Wiener process. The model parameters in Eq. (1) have a time subscript, because they can shift over time with the monetary policy regime change to inflation targeting. Let I_t indicate the monetary policy regime change to inflation targeting in October 1992

$$I_t = \begin{cases} 1 & \text{if } t \geq \text{October 1992} \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

The term to the left of the summation sign in Eq. (1) is the mean-reverting component of the short rate process. The mean reversion coefficient ϕ_t measures the speed of the mean reversion to the time-varying central tendency μ_t. With single factor models the mean-reverting level of the short rate is a constant (e.g., Chan et al., 1992).[2] The mean reversion coefficient has to be larger than zero to bring the short rate back to the mean over time. The size of the mean reversion coefficient is otherwise unrestricted for a continuous-time interest rate model. The speed of the mean reversion can change with the shift in monetary policy to inflation targeting

$$\phi_t = \phi + d_\phi I_t \tag{3}$$

where the coefficient d_ϕ measures the size of the shift in the mean reversion parameter due to the change in the monetary policy regime.

The term on the right of the summation sign in Eq. (1) shows the diffusion process. The coefficients $\sigma_{0,t}$ and $\sigma_{1,t}$ determine the volatility of the diffusion process and, subsequently, the volatility of the real interest rate around the time-varying mean.[3] The volatility parameters can shift with the monetary policy regime change to inflation targeting

$$\sigma_{0,t} = \sigma_0 + d_{\sigma,0} I_t \tag{4}$$

$$\sigma_{1,t} = \sigma_1 + d_{\sigma,1} I_t \tag{5}$$

where the coefficients $d_{\sigma,0}$ and $d_{\sigma,1}$ measure the size of the shift in the volatility parameters. When $\sigma_{0,t} = 0$ for all t the diffusion process has the volatility specification of the Cox et al. (1985) model (henceforth CIR). In the heteroskedastic model of CIR the volatility of the short rate depends on the square root of the level of the short rate. When $\sigma_{1,t} = 0$ for all t the diffusion has the volatility specification of the Vasicek (1977) model. The volatility of the short rate is constant in the homoskedastic model of Vasicek and, hence, independent of the level of the short rate.

We also need to model the time-varying mean reverting level μ_t of the real short rate. Balduzzi et al. (1998) use the yield curve to capture the time-varying mean of the short rate. They propose an affine term-structure model in which bond prices depend on the short rate and the mean-reverting level of the short rate

$$\ln P(r_t, \mu_t; \tau) = -C_t(\tau) - B_t(\tau) r_t - D_t(\tau)\mu_t \tag{6}$$

where $P(r_t, \mu_t; \tau)$ is the price of a zero-coupon bond with maturity τ. The term-structure parameters $B_t(\tau)$, $C_t(\tau)$, and $D_t(\tau)$ have a time subscript, because they can change with the monetary policy regime shift to inflation targeting in October 1992. Subject to the initial condition that $B_t(0) = 0$ the term-structure parameter for the impact of the short rate on the bond price becomes

$$B_t(\tau) = \frac{2(e^{\delta\tau} - 1)}{(\delta + \phi_t)(e^{\delta\tau - 1}) + 2\delta} \tag{7}$$

where

$$\delta = \sqrt{\phi_t^2 + 2\sigma_{1,t}^2} \tag{8}$$

In Eq. (6) bond prices depend on the short rate and the mean-reverting level μ_t of the short rate. Balduzzi et al. (1998) derive a measure of the time-varying mean-reverting level that is independent of the short rate. Consider two zero-coupon bond yields with maturities equal to τ_1 and τ_2

$$y_t(\tau_i) = \frac{C_t(\tau_i) + B_t(\tau_i) r_t + D_t(\tau_i)\mu_t}{\tau_i} \tag{9}$$

where $i = 1, 2$. Solve one of the two equations in Eq. (9) for r_t and substitute it into the remaining second equation to obtain a measure

[2] A constant mean-reverting level is empirically restrictive and, therefore, models with a time varying mean have been proposed in the literature. The double decay model of Beaglehole and Tenney (1991) is a famous early example of a term-structure model with a time-varying mean. With this model the mean-reverting level follows another continuous-time process and, therefore, it is also known as stochastic mean model.

[3] Besides the volatility parameters $\sigma_{0,t}$ and $\sigma_{1,t}$ also the speed of the mean reversion ϕ_t affects the volatility of the real interest rate. The lower the speed of mean reversion the further the real interest rate deviates from the time-varying mean-reverting level for a given volatility of the diffusion process.