THE CHANGING BEHAVIOR OF THE TERM STRUCTURE OF POST-WAR U.S. INTEREST RATES AND CHANGES IN THE FEDERAL RESERVE CHAIRMAN. IS THERE A LINK?*

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Abstract

Using U.S. interest rate data covering the period 1950:1-1992:7, this paper tests the rational expectations model of the term structure of interest rates. We show evidence that the rational expectations model of the term structure is supported by the data during the seventies and a period lasting from the mid-eighties to the end of the sample. However, during the fifties, sixties and a period that covers most of the Volcker's office term (from September 1979 to April 1986) the term structure model is rejected by the data. Moreover, we find evidence of regime changes in the short-term rate process and the term structure of interest rates. These regime switches roughly coincide with changes in the Federal Reserve chairman. The switches in monetary policy taking place when the chairmanship of the Federal Reserve changes therefore seem to play an important role in characterizing the term structure of interest rates.

Key words: term-structure, rational expectations, regime changes
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1 INTRODUCTION

In a recent paper Blinder (1997) argues that the term structure model is a key element for macroeconomic policy in order to bridge the gap between the nominal short-term interest rate set by monetary policy and the real long-term rates that presumably influence aggregate demand. The expectations theory of the term structure of interest rates postulates that a nominal long-term interest rate is the present value of current and expected future nominal short-term interest rates plus a term premium. There is a great deal of literature showing evidence that the data reject the joint hypothesis of the expectations theory of term structure and rational expectations.[1] Recently, McCallum (1994) has argued that the empirical evidence found in previous studies can be reconciled with the expectations theory under rational expectations by assuming that monetary policy involves smoothing of a short-term interest rate, responses to the level of the spread between a long-term rate and a short-term rate, and an exogenous random term premium.[2]

By allowing for changes in the short-term rate process, this paper provides mild evidence supporting the rational expectations hypothesis of the term structure for long periods of time during U.S. post-war. More important, using the 1-month U.S. Treasury bill rate and the U.S. Treasury 20-year yields from 1950 to 1992, we find four different sub-periods in which the process characterizing the short-term interest rate and the term structure of interest rates have changed.[3] Interestingly, these switches in the term structure roughly coincide with changes in the chairmanship of the Federal Reserve. This finding is consistent with the evidence found by Peek and Wilcox (1987) that significant changes in monetary policy parameters took

[1] See, for instance, Shiller (1979), Campbell and Shiller (1987), Chow (1989) and Campbell (1995). Recent papers by Hardouvelis (1994), Gerlach and Smets (1997), and Domínguez and Novales (2000) have found empirical evidence in favor of the rational expectations hypothesis of the term structure using international data. However, the first two papers also found empirical evidence that the rational expectations hypothesis of the term structure does not fit well U.S. interest rate data.

[2] McCallum's model is a formalized extension of Mankiw and Miron's (1986) argument that the failure of the rational expectations hypothesis of the term structure is due to the interest rate smoothing characterizing the Fed's monetary policy after its founding in 1914. McCallum's model has been tested by Hsu and Kugler (1997). Using data at the short end of the maturity spectrum (one and three month Euro dollar rates), they find evidence supporting McCallum's model and the rational expectations hypothesis of the term structure for the most recent sub-sample considered (period 1987-1995).

[3] Mankiw and Miron (1986) suggested in their conclusions that a test of the rational expectations hypothesis of the term structure of interest rates under different monetary regimes using short-term and long-term rates would be useful for macroeconomic policy. This paper follows their suggestion.

place leading to changes in the reduced form for interest rates when the Federal Reserve chairman changed. Moreover, the evidence provided by Mankiw and Miron (1986) and Mankiw, Miron and Weil (1987) when examining the effects of the establishment of the Federal Reserve in 1914 and the evidence reported in this paper during the U.S. post-war suggest a long-standing causal relation between institutional changes and the behavior of the term structure of interest rates.

We argue that McCallum´s argument of the recurrent failure of the empirical tests of the rational expectations of the term structure found in many studies can be viewed as a particular argument associated with a more general explanation that itself involves several aspects. First, one would expect in general a feedback relationship from the long-term rate to the short-term rate. This feedback can be rationalized, as it was by McCallum, as the result of a monetary policy in which the short-term rate responds to the level of the spread between the long-term rate and the short-term rate. However, there are other ways of explaining this feedback. For instance, in a context with asymmetric information, the long-term rate can summarize private information about the future behavior of interest rates and, therefore, a long-term rate can be used to forecast the future evolution of a short-term interest rate. Second, given the nature of the forces (monetary policy, aggregation of information) summarized by the feedback relationship, this relationship is likely to change over time. A possibility is that the short-term rate may react differently to the spread depending on how tight monetary policy is. Another possibility is that the feedback relationship may change due to variations in the long-term rate volatility. The intuition is that the information content of the long-term rate to forecast the short-term rate may depend on the volatility of the long-term rate. One expects that the higher (lower) the volatility of a long-term rate is, the lower (higher) the informational content given to a long-term rate must be when the short-rate is forecast. As shown below in Figure 1, the volatility of the long-term rate seems to have drastically changed over the post-war period. To sum up, we argue that any short-term rate process assumed in empirical studies in order to test the rational expectations hypothesis of the term structure should be viewed as a reduced form that summarizes both behavioral relationships and economic policy rules. Therefore, the parameters characterizing this reduced form are likely to vary over time.

These considerations suggest that a 'fair' test of the rational expectations hypothesis of the term structure of interest rates should be carried out by taking into account the possibility of changes in the process characterizing the short-term interest rate. This strategy was also followed by Mankiw and Miron (1986) and Hamilton (1988), although this paper differs in many aspects from their papers. First, Mankiw and Miron use OLS regression. Hamilton uses his Markov regime-switching maximum likelihood technique to estimate the model. Here, we use the method of simulated moments. Second, Mankiw and Miron study the term structure of interest rates at the short end of the maturity spectrum (3-month and 6-month rates) using quarterly data from 1890 to 1979. Hamilton uses quarterly yields on 3-month Treasury bills and 10-year Treasury bonds from 1962 to 1987. We use monthly yields data on different terms covering the post-war period. Third, our estimation results point to the presence of regime changes in 1970 and 1986 as well as the one detected in 1979 by Hamilton's study. One possible explanation for these differences (apart from the obvious ones such as the use of different data sets and different econometric techniques) is that Hamilton only allows for the presence of two states since the focus of his paper is to detect the major regime-switching in monetary policy occurring in October 1979. Thus, the presence of minor changes in regime such as those occurring in 1970 and 1986 may have passed unnoticed in Hamilton's analysis.

The rest of the paper is organized as follows. Section 2 introduces the present value model of interest rates under rational expectations which allows for the presence of feedback from the long-term rate to the short-term rate. Section 3 presents and discusses the empirical evidence. Moreover, the robustness of the estimation results is assessed. Finally, Section 4 shows the conclusions.

2 THE PRESENT VALUE MODEL OF INTEREST RATES

As shown by Shiller's (1979) seminal paper, the rational expectations theory of the term structure of interest rates postulates the following relation between a long-term rate and a short-term rate

$$R_t = (1-\delta)\sum_{i=0}^{\infty}\delta^i E_t r_{t+i} + u_t, \qquad (1)$$

where R_t denotes a long-term rate at time t, r_t is a short-term rate at time t, E_t denotes the conditional expectation operator given the information set, I_t, available to the economic agents at the beginning of time t. I_t includes current and past values of all random variables included in the model. δ denotes the discount factor and u_t is a random error term. We assume that u_t follows an $AR(1)$

$$u_t = \lambda_0 + \lambda_1 u_{t-1} + z_t, \quad (2)$$

where λ_0 is a constant, $|\lambda_1|$ □ 1 and z_t is an i.i.d. random error with mean zero and variance σ_z^2. u_t is often associated with a term premium that is usually assumed constant. However, we share McCallum's view (1994) that it seems implausible that there would not be some period-to-period variability in the error term u_t in (1) since a term such as this reflects changes regarding the need for financial flexibility, measurement error and other disturbing influences. The important point is that the inclusion of u_t in (1) keeps the essence of the expectations theory of the term structure, that is, the long-term rate differs from a weighted average sum of expected future short-term rates only randomly.

We further assume that the short-term interest rate r_t is characterized by the following process

$$r_t = \rho_0 + \rho_1 R_{t-1} + \rho_2 r_{t-1} + v_t, \quad (3)$$

where ρ_0 is a constant, ρ_1 and ρ_2 are both included in the interval $[-1, 1]$, and v_t is a random variable with mean zero.[4] v_t is included in I_t since r_t is also included. Equation (3) is a reduced form characterizing the short-term rate that allows for the presence of a positive feedback from the long-term-rate to the short-term rate. This positive feedback relationship can be rationalized in several ways. One possibility is that the feedback arises by aggregation of asymmetric information, thus, a long-term rate aggregates private information that can be used to predict the evolution of a short-term rate. Another possibility is that the feedback appears when monetary policy uses short-term interest rate as an instrument (as in McCallum (1994)).

Taking into account equation (1) to evaluate $E_t R_{t+1}$ and subtracting $\delta E_t R_{t+1}$ from (1) we obtain

$$R_t = (1 - \delta) r_t + \delta E_t R_{t+1} + u_t. \quad (4)$$

Equations (3) and (4) form a bivariate system of difference equations. Using the undetermined coefficient method (Muth (1961), McCallum (1983) among others) we begin by writing R_t as a linear function of a minimal set

[4]We assume that v_t is an i.i.d. random variable with mean zero and variance σ_v^2. In addition, we also estimate the model by allowing for v_t following an $AR(1)$ process: $v_t = \tau_1 v_{t-1} + s_t$, where s_t is an i.i.d. random variable with mean zero and variance σ_s^2. As shown in Table 3 below, we cannot reject the null hypothesis that τ_1 is statistically equal to zero (that is, v_t is a white noise). These results suggest that considering more lagged values of R_t and r_t other than those appearing in (3) is not required.