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A random walk approach to predicting US 30-year home mortgage rates

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ABSTRACT

Following the implications of term structure theory in an efficient bond market, this study formulates a random walk model that produces unbiased and efficient forecasts of the 30-year mortgage rate for 1987–2006. Forecast accuracy improves with a reduction in lead time but deteriorates with an increase in the forecast horizon. We find, however, no clear trend indicating that forecast accuracy has improved over time. From a more practical perspective, the random walk forecasts of the 30-year mortgage rate and prepayment premium (the spread between 30-year mortgage and 10-year Treasury rates) accurately predict directional change and thus are of value to a user. In exploring the view that the 30-year mortgage rate often moves in tandem with the 10-year Treasury rate, we further find that these rates are cointegrated and thus converge to an equilibrium relation in the long-run.

1. Introduction

Coupled with the time invariant term premium assumption, the hypothesis of bond market efficiency suggests that long-term interest rates approximately follow a random walk (Pesando, 1979). A random walk behavior implies that such rates rapidly and fully reflect all relevant information so that future rate changes deviate from zero only in response to unanticipated events. It is widely held that the 30-year home mortgage rate often moves in tandem with the 10-year Treasury rate and is thus expected to exhibit similar stochastic behavior in an efficient market. As the first step in this study, we ask whether the random walk forecasts of the 30-year mortgage rate with varying lead times and forecast horizons are accurate. The answer to this question is important to individuals and businesses in making asset-allocation decisions and to policymakers who closely monitor changes in the interest-rate-sensitive housing market activity for clues about the near-term performance of the economy.[1]

As shown below, the random walk model generally produces both unbiased and efficient forecasts and accurately predicts the direction of change in the 30-year mortgage rate. Interestingly, existing studies evaluating the survey forecasts of long-term interest rates report unfavorable findings. Friedman (1980), for instance, concludes that the survey forecasts of utility and high-grade municipal bond rates from the biweekly *Goldsmith-Nagan Bond and Money Market Letter* are not rational. Kolb and Stekler (1996) and Brooks and Gray (2004) show that the survey forecasts of the 30-year US Treasury rate from the *Wall Street Journal* fail to outperform the naïve random walk forecasts. The study by Baghestani (2006) further reveals that the forecasts of 10-year Treasury and Moody's Aaa corporate bond rates from the *Survey of Professional Forecasters* are biased. In light of such survey evidence, we believe the findings of this study are important and merit attention.

As the second step in this study, we explore the relation between the rates on 30-year mortgage and 10-year Treasury. These rates are shown to be cointegrated and thus converge to an equilibrium relation in the long-run. Additional findings indicate that the 10-year Treasury rate is not purely a random walk. Within the autoregressive integrated moving-average (ARIMA) modeling framework, a

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[1] See the Federal Reserve Bank of New York website at http://www.ny.frb.org/education/bythe.html.

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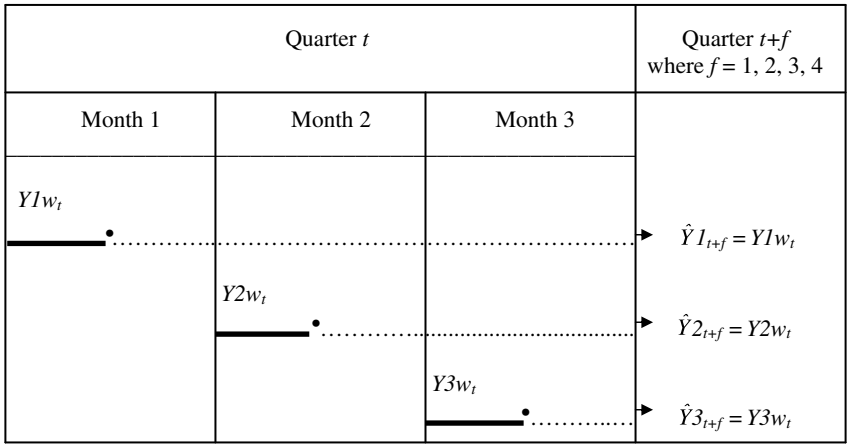

Fig. 1. Timeline of the three sets of random walk forecasts made in quarter t. *Notes*: $Y1w_t$ denotes the average rate for the first two full weeks of the first month of quarter t. Similarly, $Y2w_t$ ($Y3w_t$) denotes the average rate for the first two full weeks of the second (third) month of quarter t. The dot (•) represents "around the middle of the month" depending on when the rate for the second full week of the month becomes available. $\hat{Y}1_{t+f}$ denotes the random walk forecasts of the 30-year home mortgage rate made around the middle of the first month of quarter t for f (=1, 2, 3, and 4) quarter(s) ahead. Similarly, $\hat{Y}2_{t+f}$ ($\hat{Y}3_{t+f}$) denotes the random walk forecasts made around the middle of the second (third) month of quarter t for f (=1, 2, 3, and 4) quarter(s) ahead.

purely random walk series is characterized as ARIMA (0,1,0). The rate on 10-year Treasury, however, can best be described as an ARIMA (0,1,1) process. We shall argue that the existence of the first-order moving-average term is not inconsistent with bond market efficiency. Moreover, we can think of the mortgage rate as being made up of the rate on 10-year Treasury plus a prepayment premium. As we shall see, the prepayment premium can also best be described as ARIMA (0,1,1). This, consistent with our findings, implies that the 30-year mortgage rate should replicate the stochastic behavior of the 10-year Treasury rate and follow an ARIMA (0,1,1) process.

This paper is organized as follows: Section 2 describes the random walk model. Section 3 presents our forecast evaluation results. Section 4 first explores the relation between the rates on 30-year mortgage and 10-year Treasury and then examines whether the random walk forecasts of the prepayment premium are of value to a user. Section 5 summarizes our findings.

2. The random walk forecasts

In this study, we examine the random walk forecasts of the 30-year mortgage rate made in the first quarter of 1986 through the fourth quarter of 2005. At each quarter t, we generate three sets of forecasts for the subsequent four quarters. With the forecast horizon f = 1, 2, 3, and 4, the first set of forecasts (denoted $\hat{Y}1_{t+f}$) is made around the middle of the first month of quarter t. The second set of forecasts (denoted $\hat{Y}2_{t+f}$) is made around the middle of the second month of quarter t, and the third set of forecasts (denoted $\hat{Y}3_{t+f}$) is made around the middle of the third month of quarter t.

Fig. 1 summarizes the timeline of the three sets of random walk forecasts made in quarter t. As indicated, the random walk forecasts made around the middle of each month are set equal to the average rate for the first two full weeks of the month. For instance, the random walk forecasts for 1990.1, 1990.2, 1990.3, and 1990.4 made around the middle of October 1989 are all set equal to the average rate for the first two full weeks of October 1989.[2] The random walk forecasts for 1990.1, 1990.2, 1990.3, and 1990.4 made around the middle of November 1989 are set equal to the average rate for the first two full weeks of November 1989. Similarly, the random walk forecasts for 1990.1, 1990.2, 1990.3, and 1990.4 made around the middle of December 1989 are all set equal to the average rate for the first two full weeks of December 1989. Thus, with Y_{t+f} denoting the actual 30-year mortgage rate in quarter $t+f$, $\hat{Y}1_{t+f}$, $\hat{Y}2_{t+f}$, and $\hat{Y}3_{t+f}$ are three sets of forecasts of Y_{t+f} made in quarter t with different lead times.

3. Forecast accuracy results

This section evaluates the random walk forecasts of the 30-year mortgage rate by answering the following six questions:

1. Are random walk forecasts unbiased?
2. Are random walk forecasts efficient?
3. Does forecast accuracy improve with a reduction in lead time?
4. Does forecast accuracy deteriorate with an increase in the forecast horizon?
5. Has forecast accuracy improved over time?
6. Are random walk forecasts of value to a user?

We begin by noting that the random walk forecasts are made in 1986.1–2005.4. Therefore, the sample periods for the one-, two-, three-, and four-quarter-ahead forecasts

[2] The first full week in October 1989 was Monday the 2nd through Friday the 6th; the second full week was Monday the 9th through Friday the 13th. Therefore, "around the middle of October 1989" refers to any day after Friday the 13th when the weekly data on mortgage rates became available. We should also note that the 30-year (conventional) mortgage rate is the average contract rate on commitments for fixed-rate first mortgages. The weekly and monthly data, collected by the Federal Home Loan Mortgage Corporation, are available on the Federal Reserve Bank of St. Louis website at http://research.stlouisfed.org/fred2.