The expectation hypothesis of the term structure of very short-term rates: Statistical tests and economic value ☆

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A R T I C L E   I N F O

A B S T R A C T

This paper reexamines the validity of the expectation hypothesis (EH) of the term structure of US repo rates ranging in maturity from overnight to 3 months. We extend the work of Longstaff [2000b. The term structure of very short term rates: new evidence for the expectations hypothesis. Journal of Financial Economics 58, 397–415] in two directions: (1) we implement statistical tests designed to increase test power in this context; (2) more important, we assess the economic value of departures from the EH based on criteria of profitability and economic significance in the context of a simple trading strategy. The EH is rejected throughout the term structure examined on the basis of the statistical tests. However, the results of our economic analysis are favorable to the EH, suggesting that the statistical rejections of the EH in the repo market are economically insignificant.

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1. Introduction

Ever since Fisher (1896) postulated the expectation hypothesis (EH) of the term structure of interest rates, this simple and intuitively appealing theory has attracted an enormous amount of attention in financial economics. Many authors argue that interest rates at different maturities move together because they are linked by the EH, and a number of studies have addressed the empirical validity of this theory. However, this literature, using a variety of tests and data, generally rejects the EH (e.g., Roll, 1970; Fama, 1984; Fama and Bliss, 1987; Frankel and Froot, 1987; Stambaugh, 1988; Froot, 1989; Campbell and Shiller, 1991; Bekaert, Hodrick, and Marshall, 1997; Bekaert and Hodrick, 2001; Clarida, Sarno, Taylor, and Valente, 2006; Sarno, Thornton, and Valente, 2007).

An important exception is provided by Longstaff (2000b), who finds that the EH is supported by the data. Longstaff (2000b) presents the first tests of the EH at the extreme short end of the term structure, using repurchase (repo) rates with maturities measured in days or weeks. There are two reasons that Longstaff's study is important.

First, if the EH cannot explain the term structure at this extreme short end, it seems unlikely that it can be of value at longer maturities. Second, the use of repo rates is especially appropriate for investigating the EH because repo rates represent the actual cost of holding riskless securities. Hence, repo rates provide potentially better measures of the short-term riskless term structure than other interest rates commonly used by the relevant literature, such as Treasury bill (T-bill) rates.

This paper revisits the EH using an updated data set of repo rates from the same source as Longstaff (2000b). Our motivation is twofold. First, the literature on testing the EH has made much progress in recent years by developing increasingly sophisticated testing procedures that are particularly useful in this context. Given the statistical problems afflicting conventional tests of the EH, in this paper we employ a test that was originally proposed in Campbell and Shiller (1987) and made operational in Bekaert and Hodrick (2001).[1] Bekaert and Hodrick (2001) develop a procedure for testing the parameter restrictions that the EH imposes on a vector autoregression (VAR) of the short- and long-term interest rates. The procedure's size and power properties have been thoroughly investigated by Bekaert and Hodrick (2001) and Sarno, Thornton, and Valente (2007). We apply this test to US repo rates ranging in maturity from overnight to 3 months over the sample period from 1991 to 2005.

Second, we move beyond testing the validity of the EH from a purely statistical perspective and provide evidence on whether deviations from the EH are economically significant. Distinguishing between statistical analysis and economic evaluation is crucial for at least three reasons: in general statistical rejections of a hypothesis do not necessarily imply economic rejections (e.g., Leitch and Tanner, 1991); statistical VAR tests of the EH do not allow for transaction costs, which are critical for exploiting departures from the EH in real-world financial markets; and very powerful statistical tests could reject virtually any null hypothesis in large samples, without necessarily being informative about the size of departures from the hypothesis tested (Leamer, 1978). All these reasons suggest that an economic assessment of the deviations from the EH is desirable to complement the statistical tests.

In a mean–variance framework, we compare the performance of a dynamic portfolio strategy consistent with the EH to a dynamic portfolio strategy that exploits the departures from the EH. We use a utility-based performance criterion to compute the fee that a risk-averse investor would be willing to pay to switch from the EH to a strategy that exploits departures from the EH to forecast interest rates. As an alternative economic measure, we also employ the risk-adjusted return of these two strategies. In short, we provide an economic test of the EH by evaluating the incremental profitability of an optimal (mean–variance efficient) strategy that relaxes the restrictions implied by the EH statement.

To anticipate our results, we find that the EH is statistically rejected for all pairs of repo rates in our sample throughout the maturity spectrum from overnight to 3 months. Our results differ from Longstaff (2000b) presumably because the VAR test is more powerful and our sample period is somewhat longer than his. However, the results of our economic analysis lend support to the EH as we find no tangible economic gain to an investor who exploits departures from the EH relative to an investor who allocates capital simply on the basis of the predictions of the EH. Specifically, the evidence in this paper shows that the economic value of departures from the EH is modest and generally smaller than the costs that an investor would incur if he were to trade to exploit the mispricing implied by EH violations. Hence, despite the statistical rejections of the EH, we conclude that the EH provides a fairly reasonable approximation to the repo rates term structure, consistent with Longstaff's interpretation of the functioning of the repo market.

The outline of the paper is as follows. Section 2 briefly describes the data and preliminary statistics on repo rates. Section 3 introduces the EH and the VAR framework within which the empirical work is carried out, with a description of the essential ingredients of the VAR testing procedure proposed by Bekaert and Hodrick (2001). We report the results from the VAR tests of the EH in Section 4. In Section 5, we outline the framework for measuring the economic value of departures from the EH in a mean–variance setting and describe the performance measures used to assess the economic significance of EH violations. Section 6 reports the results on the validity of the EH using economic value measures. The conclusions are presented in Section 7. The Appendix provides technical details on the VAR framework and estimation issues.

2. Data

The data set is made up of daily observations of the closing overnight i_t, 1-week $i_t^{(1w)}$, 2-week $i_t^{(2w)}$, 3-week $i_t^{(3w)}$, 1-month $i_t^{(1m)}$, 2-month $i_t^{(2m)}$, and 3-month $i_t^{(3m)}$ general collateral government repo rates, from May 21, 1991 to December 9, 2005. The data are obtained from Bloomberg and the source of the data is Garban, a large Treasury securities broker. Repo rates are quoted on a 360-day basis and the rate quotations in Bloomberg are given in increments of basis points (bps). The total number of daily observations available is 3,625 and is essentially an update of the data set used by Longstaff (2000b).[2]

Table 1 reports the summary statistics for repo rates, in level and first difference. All variables are expressed in percentage points per annum. The data display similar

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[1] Tests that are commonly used to investigate the EH could generate paradoxical results due to finite sample biases, size distortions, and power problems (e.g., see Campbell and Shiller, 1991; Bekaert, Hodrick, and Marshall, 1997; Thornton, 2005, 2006).

[2] Professor Longstaff kindly checked the consistency of our data set with the data used in Longstaff (2000b), which covered the sample from May 21, 1991 to October 15, 1999. Only days for which a complete set of rates for all maturities is available are included in the sample. This resulted in 42 days being dropped from the sample. Finally, the period September 11, 2001 through September 30, 2001 is not available.