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A test of the expectations hypothesis in very short-term international rates in the presence of preferred habitat for liquidity

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ABSTRACT

This study incorporates year-end and quarter-end preferences for liquidity and other calendar-time effects into the test of the expectations hypothesis (EH) in the very short-term LIBOR (maturities of one month and shorter) in seven major world currencies. The calendar-time effects are found to alter long-term relations between very short-term rates in these currencies. These effects alone are not responsible for the rejection of the EH in the data, as it is rejected in most of the cases even after appropriate controls are introduced. However, such effects are capable of causing the EH to be rejected and should be controlled for when testing the EH in very short-term rates.

1. Introduction

The expectations hypothesis (EH), one of the oldest and most widely tested propositions in economics and finance, states that future expected interest rates are implied by the current term structure. The pure form of the EH posits that the return on holding a long-term bond to maturity should be equal to the expected return on investment in a series of short-term bonds over the life of the long-term bond.[1]

The preferred habitat theory (PH) was proposed by Modigliani and Sutch (1966) to add to the explanation of the term structure. According to the PH, investors who for some reason prefer certain maturities may be induced to invest in other maturities if offered a sufficiently large premium. Ogden (1987) identifies the end of the month and especially the end of the year as a preferred habitat for lenders in the U.S. money markets. He reports that a disproportionately large share of cash obligations (e.g., interest and dividend payments, year-end bonuses) is scheduled around month-ends. Griffiths and Winters (1997, 2005) find abnormally high rates prior to the year-end in U.S. money market instruments; the rates start declining to "normal" levels prior to the year-end. This pattern is consistent with a year-end being PH for lenders suggested by Ogden (1987). Investors who have cash obligations to pay prior to the end of a year would prefer to invest in money market securities that mature prior to their cash obligation dates (which do not have to align precisely with the last day of the year). Griffiths and Winters (1997, 2005) dub this effect a *preferred habitat for liquidity*. Kotomin, Smith, and Winters (2008) test for year-end and quarter-end effects in short-term LIBOR in 11 currencies and find patterns consistent with the year-end PH for liquidity in the one-week and one-month LIBOR for the world's major currencies—the U.S. Dollar, the Euro, the Japanese Yen, and the Swiss Franc. The one-week and one-month LIBOR yields increase significantly two days before the maturity of the loan starts to span the end of the year and returns to normal levels starting on the third-to-last trading day of the year.

This study builds on the findings of Kotomin et al. (2008) and tests whether the expectations hypothesis holds when the PH for liquidity is controlled for. I use overnight LIBOR as a short-term rate, and one-week, two-week, and one-month LIBOR as long-term rates. If investors' preference for year-end liquidity manifests itself in abnormally high long rates prior to the end of the year, the long-term relation between long and short rates is temporarily distorted. This distortion may lead to a rejection of the EH at the short end of the term structure, such as in Downing and Oliner (2007), who find that the EH is rejected before but not after controlling for the year-end increase in commercial paper yields in the U.S. This study confirms that the PH for liquidity and other calendar-time effects certainly alter the relations between very short-term rates in the world's major currencies. The EH is still rejected in most of the cases after the year-end and quarter-end PH for liquidity and other

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[1] This statement is true in the case of certainty. For uncertain interest rates, deviations between long- and short-bond returns should follow a zero-mean white noise process. The pure EH assumes risk-neutral investors, who require no premium when investing in a long-term bond. If investors are risk averse and thus prefer the less risky short-term securities, the pure EH does not hold. Investors can still be induced to hold longer-term, more risky securities if offered extra yield (a term premium). The term premium for a given maturity must be constant for the EH to hold.

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controls are introduced. Regression fit improves in every case after introducing these controls, and the estimated coefficients of the PH for liquidity variables are significant for the majority of interest rate pairs. It is clear that the PH effects impact the relations between short and long rates in some of the major world currencies. These effects should be controlled for when testing the EH at the short end of the term structure.

2. Background and hypotheses

The EH implies that a long-term rate equals an average short-term rate over the lifespan of a long-term rate plus a constant term premium. A common parameterization used to test the EH is

$$\frac{1}{k}\sum_{t}^{t+k-1} {r_t}^m - r_t^n = a_0 + \beta_1 r_t^n + \varepsilon_t, \quad (1)$$

where r^m is the short (m-period) rate, r^n is the long (n-period) rate, and $k = n/m$ is an integer. The intercept is a term premium, which must be statistically equal to zero for the pure form of the EH to hold. The slope coefficient must not be different from zero for the EH to hold; that is, the level of the long rate must not have predictive power for the spread between the average short rate and the long rate. Another frequently used parameterization is

$$\frac{1}{k}\sum_{t}^{t+k-1} r^m - r_t^m = a_0 + \beta_1(r_t^n - r_t^m) + \varepsilon_t. \quad (2)$$

If the EH holds, beta in (2) will be indistinguishable from one; that is, the spread between the long and short rates will not have predictive power for the future short-term rate behavior. If the pure form of the EH holds, the intercept must be statistically equal to zero in addition to beta being statistically indistinguishable from one.

Numerous empirical tests of the EH have been undertaken. Overall, they have rejected the EH more often than they have failed to do so, especially at the short end of the term structure. The most widely discussed explanations of the EH failure are time-varying term premia, irrationality of market participants, and overreaction of market participants to monetary policy changes.[2] Longstaff (2000) is a notable exception. He tests the EH using (1) and finds that pure expectations hold in the term structure of U.S. repurchase agreement (repo) rates over the period May 21, 1991 through October 15, 1999. In his study, an overnight repo rate is the short rate, while term repo rates are the long rates. Brown, Cyree, Griffiths, and Winters (2008) reexamine the finding of Longstaff (2000) because they find it surprising that the EH holds in the market known to have a year-end increase in term repo rates consistent with PH for liquidity (Griffiths & Winters, 1997). Brown et al. (2008) conclude that Longstaff's results are sample-specific as the EH does not hold in out-of-sample data (relative to the Longstaff's sample) even after controlling for preferred habitat effects.[3]

Downing and Oliner (2007) test the EH in the U.S. commercial paper (CP) market using an overnight CP rate as a short rate. The CP market is characterized by large yield increases in term CP (maturities longer than overnight) at the end of the year related to preferred habitat for liquidity (Griffiths & Winters, 2005). While Downing and Oliner (2007) do not attribute this yield behavior to the year-end PH for liquidity, they find the results are more supportive of the EH when they control for the year-end yield increases. The dealer-quoted data collected prior to 1998, however, reject the EH even after controlling for the year-end effect.

This study examines whether the PH for liquidity-related year-end and quarter-end increases in short-term LIBOR (maturities between one week and one month) for major world currencies identified by Kotomin et al. (2008) are responsible for the rejection of the EH when overnight LIBOR is the short-term rate.[4]

Among the three common explanations of the EH failure – time-varying risk premia, irrationality of market participants, and overreaction to monetary policy changes – the phenomenon studied herein is clearly related to the time-varying premia since calendar-time liquidity preferences are rational and do not arise in response to monetary policy changes. When the spread between long and short rates changes prior to the end of the year or quarter due to investors' liquidity preferences, the EH may be rejected because of this temporary (and regular) distortion to the long-run relation between the rates. To my knowledge, Brown et al. (2008) and Downing and Oliner (2007) are the only studies that test the EH while controlling calendar-time effects in short-term interest rates. Given their findings, the year-end and quarter-end PH for liquidity may or may not cause the expectations hypothesis to be rejected at the short end of the term structure. I hypothesize that the EH will be rejected in the currencies with identified year-end and quarter-end yield changes when these changes are not controlled for and may not be rejected when they are.

3. Data

The data represent daily fixings of the London Interbank Offer Rate (LIBOR) by the British Bankers Association (BBA). Longstaff (2000), Brown et al. (2008), and Downing and Oliner (2007) all employ a one-day (overnight) rate as a short rate in their tests of the EH. I test the EH using overnight LIBOR as the short rate and one-week, two-week, and one-month LIBOR as long rates. Overnight LIBOR data are available from the beginning of 2001 for the following seven currencies: U.S. Dollar (USD), Pound Sterling (GBP), Euro, Japanese Yen (JPY), Swiss Franc (CHF), Australian Dollar (AUD), and Canadian Dollar (CAD). I chose the sample period to end on April 30, 2007, due to the global financial crisis that started affecting the money markets in the summer of 2007 and led to extremely high volatility in short-term rates over the next two years.

BBA LIBOR is the primary benchmark for short-term interest rates globally and is used as the basis for settlement of interest rate contracts on many of the world's major futures and options exchanges as well as many over-the-counter (OTC) and lending transactions.[5] Kotomin et al. (2008) find that one-week and one-month LIBOR in U.S. Dollar (USD), Japanese Yen (JPY), Euro (EURO), and Swiss Franc (CHF) have a pronounced year-end effect and a smaller quarter-end effect consistent with preferred habitat for liquidity. In particular, the one-week and one-month LIBOR spreads over longer-term LIBOR in these currencies increase two days before the loan maturity starts spanning the end of the year (i.e., the second-to-last trading day of November in the case of the one-month maturity) or quarter and stay high through the third-to-last trading day of the year or quarter, after which they start to return to the "normal" levels. Kotomin et al. (2008) do not find such effects

[2] E.g., Campbell and Shiller (1991), Cook and Hahn (1990), Fisher and Gilles (1998), Tzavalis and Wickens (1997).

[3] Della Corte, Sarno, and Thornton (2008) also re-examine Longstaff (2000) using different methods and find that the EH is rejected in the term structure of repo rates but departures from the EH are not economically significant.

[4] I refer to the end of the fourth quarter as the year-end, and to ends of the first three quarters as quarter-ends hereafter.

[5] BBA LIBOR is the British Bankers Association's fixing of the London Inter-Bank Offered Rate. It is based on offered interbank deposit rates provided in accordance with the instructions to BBA LIBOR Contributor Banks. For a complete description of LIBOR, see the BBA LIBOR web site at http://www.bbalibor.com.