Empirical Evidence on Term Structure of Interest Rates

1) Testing the Expectations Theory

In this section, we present the empirical evidence on the expectations theory. As the benchmark term structure model, the expectations theory generally has two forms. Its strong form assumes that the long-term yield is equal to the average of the future expected short-term rates. The weak form loosens its assumption and introduces a constant term premium of the long-term yield over the averaged short-term rates. While this premium can be maturity specific, it is constant over time. This weak form is also referred to as the liquidity premium theory or biased expectations theory.

The stylized fact that yield curves usually slope upwards contradicts the strong form of the expectations theory, as it will imply a consistently upward trend of the short-term rates. Therefore, the weak state of the expectations theory is generally more accepted in the literature of empirical evidence in this field. We will refer to the expectations theory as its weak form for the remainder of this section.

One of the most influential and pioneering work in testing the expectations hypothesis is Campbell and Shiller (1991). They came up with two tests based on the following implication of the expectations theory: a steeper yield curve implies that short rates and long rates are expected to increase. The reason is that a steeper yield curve means long-term forward rates are higher than short-term forward rates, given the expectations theory. In contrast, if the yield curve is flatter, the short rates and long rates are expected to fall.

Their first test is based on the implication that the -period interest rate is the future average m-period rate over the next intervals, with each having length with each having length . For example, the 10-year interest rate should be the expected average 2-year interest rate over the next 5 = 10/2 intervals, each of length equal to 2 years. Formally, the equation is as follow if we neglect a constant:

which implies that

This leads Campbell and Shiller (1991) to consider the following regression:

This regression is essentially regressing the weighted average of future short-term rate changes onto the yield spread. Then based on the equations above, this regression ought to give a coefficient equal to one. Campbell and Shiller (1991) found that the estimations of the slope coefficients for different and are generally all positive but less than one based on the postwar U.S. term structure data from 1952 to 1987. Among the coefficients, some are significantly different than 1. Gurkaynak and Wright (2012) used updated data from 1971 to 2009 to perform the same test and derived a similar result as in Campbell and Shiller (1991). These results provide evidence that is weakly against the expectations theory.

The second test that Campbell and Shiller (1991) proposed is built on the implication that the future expectations of interest rate from to periods () is the forward rate over the according period. This means

if we neglect a constant. And we can have the following regression:

which is essentially regressing the change of long-term yields onto the yield spread of the term structure, adjusted by and . The coefficient should again be one. Based on this, Campbell and Shiller (1991) found that the estimates of the slope coefficients for different and are all negative and significantly different than one. Moreover, the coefficient becomes more negative with increasing . Intuitively, this means that a steeper yield curve will cause the long-term yield to fall in the future instead of to rise according to the expectations hypothesis. Gurkaynak and Wright (2012) also concluded a similar result with the updated data. This provides strong evidence against the expectations theory and has been well-known in the literature, dated back to Frederick R. Macaulay (1938). As pointed out in Gurkaynak and Wright (2012), this anomaly is closely related to the result in Shiller (1979). In this paper, Shiller found that the long-term interest rates are too volatile to be average rational expectations of future short-term yields.

Fama and Bliss (1987), Backus et al. (2001), Duffee (2002), and Cochrane and Piazzesi (2008) considered another approach to testing the expectations theory. They try to regress the excess returns of holding an -year bond for years over the return of holding an -year bond for the same period onto the yield’s term structure at the start of the holding period. Based on that, Cochrane and Piazzesi (2008) again rejected the hypothesis indicated by the expectations theory.

Though there is a decent amount of empirical evidence in the literature against the expectations theory, some researchers pointed out caveats with these testing approaches. First is the econometric issues under relatively short spans of data and the risk of a spurious regression. Second is that the regression does not immune from the possibility of an unprecedented regime shift that will affect the pricing of yields. And this is potentially harmful in a small sample. Bekaert and Hodrick (2001) studied the tests in Campbell and Shiller (1991) while considering these problems in small samples. Even though, they continue to reject the expectations theory.

Given the abundant evidence that rejects the expectations theory, one well-accepted explanation is that the risk premia changes over time. In the following section, we will present some other empirical evidence that focuses on the theory trying to overcome the drawback of the expectations theory.

2) Empirical Evidence on Preferred Habitats Theory

Modigliani and Sutch (1966, 1967) provided an interesting attempt called preferred habitats theory to overcome the shortage of the expectations hypothesis. In preferred habitats theory, markets are segmented, different investors prefer different maturity bonds. The interest rate is then determined by the supply and demand of the specific market segment.

One empirical evidence that supports this is the bonds in November and December 2008. During that time, the thirty-year bonds issued in the late 1980s, having about seven years left to maturity had considerably higher yields than the ten-year notes with the same time to maturity. This should be considered as an arbitrage opportunity for arbitragers. But this discrepancy lasted, providing a strong evidence of market segmentation and the preferred habitats theory.

Besides this, Gagnon et al. (2010) claimed that the Federal Reserve's large-scale purchases did substantially lower the long-term benchmark interest rate and yields on both Treasuries and mortgage-backed securities. This supports the preferred habitats theory that the pricing of the bond is determined by the supply and demand of the specific market segment. D’Amico and King (2010) provided a similar argument by comparing the prices of bonds that the Federal Reserve bought with other bonds. In short, though this theoretical model is not as easy to justify as the expectations theory, the preferred habitats theory provides a valuable approach especially at special times when the economy is under turmoil such as 2008.