

**Expectations Hypothesis of the Term Structure,  
 the Liquidity Premium and Economic Activity**

***Expectations Hypothesis of the Term Structure: Math***

If agents are risk neutral.

$$P_{1t} = \frac{\$100}{1 + i_{1t}} \quad (1)$$

$$P_{2t} = \frac{\$100}{(1 + i_{1t})(1 + i_{1t+1}^e)} \quad (2)$$

To see what this implies, consider what is true if both one year and two year bonds offer the same one-year return (by arbitrage); then:

$$1 + i_{1t} = \frac{P_{1t+1}^e}{P_{2t}} \quad (3)$$

Rearranging:

$$P_{2t} = \frac{P_{1t+1}^e}{1 + i_{1t}} \quad (4)$$

What is the numerator of the right hand side of (4)? Iterating (1) forward, and taking expectations:

$$P_{1t+1}^e = \frac{\$100}{1 + i_{1t+1}^e}$$

This can be substituted into (4) to obtain:

$$P_{2t} = \frac{\$100}{(1 + i_{1t+1}^e)(1 + i_{1t})} \quad (5)$$

We know in fact:

$$P_{2t} = \frac{\$100}{(1 + i_{2t})^2} \quad (6)$$

What will set (5) equal to (6)?

$$\frac{\$100}{(1 + i_{2t})^2} = P_{2t} = \frac{\$100}{(1 + i_{1t+1}^e)(1 + i_{1t})}$$

Which implies:

$$(1 + i_{2t})^2 = (1 + i_{1t+1}^e)(1 + i_{1t})$$

$$(1 + 2i_{2t} + i_{2t}^2) = (1 + i_{1t+1}^e + i_{1t} + i_{1t+1}^e i_{1t})$$

$$2i_{2t} \approx i_{1t+1}^e + i_{1t}$$

$$\boxed{i_{2t} \approx \frac{1}{2}(i_{1t+1}^e + i_{1t})} \quad (7)$$

$$i_{1t+1}^e = 2i_{2t} - i_{1t} \quad (8)$$

In general:

$$\boxed{i_{nt} = \frac{(i_{1t} + i_{1t+1}^e + \dots + i_{1t+n-1}^e)}{n}} \quad (9)$$

### ***The Liquidity Premium Theory of the Term Structure***

The linkage between the long-term and short-term interest rates can be decomposed thus:

$$i_{nt} = \frac{(i_{1t} + i_{1t+1}^e + \dots + i_{1t+n-1}^e)}{n} + tp_{nt} \quad (10)$$

Where  $i_{nt}$  is the interest rate on a bond of maturity  $n$  at time  $t$ ,  $i_{1t+j}^e$  is the expected interest rate on a one period bond for period  $t + j$ , based on information available at time  $t$ , and  $tp_{nt}$  is the liquidity (or term) premium for the  $n$ -period bond at time  $t$ . This specification nests the expectations hypothesis of the term structure (EHTS) (corresponding to the first term on the right hand side of equation 10), and the liquidity premium theory (corresponding to the second term).

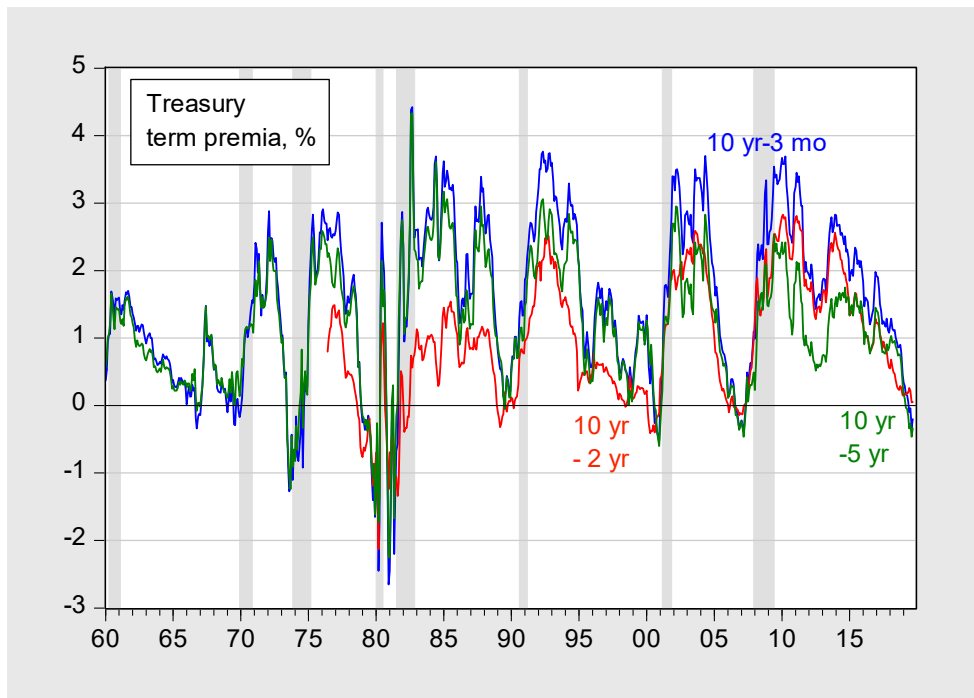
The EHTS merely posits that the yield on a long-term bond is the average of the one period interest rates expected over the lifetime of the long bond. The liquidity premium theory allows that there will be supply and demand conditions that pertain specifically to bonds of that maturity (this is the segmented markets hypothesis). The presence of idiosyncratic effects associated with a certain maturity of bond is sometimes linked to the “preferred habitat theory”, the idea that certain investors have a preference for purchasing assets of specific maturities. Since  $l_t^n > 0$  and is expected to rise as  $n$  becomes large, the yield curve will slope upward when short rates are expected to be constant over time. The liquidity or term premium is assumed to rise with maturity  $n$  because holders of longer term bonds face greater interest rate risk.

Now, for the sake of simplicity, consider the case where  $tp_{nt} = 0$  (i.e., the EHTS explains all variation in long rates). Suppose further expected short rates are lower than the short rate today. Then the long rate will be lower than the short rate (i.e., the yield curve inverts).

Since low interest rates are typically associated with decreased economic activity, an inverted yield curve should imply an expected downturn, especially given that  $tp_{nt} > 0$ , then an inversion should imply a downturn a fortiori.

### ***Application to the United States***

One of the implications of the EHTS is that expectations of a sequence of low short term rates in the near future will result in the long rate being lower than usual. Short term interest rates are typically low when the economy has encountered a slowdown, or has entered in a recession. At the same time, many recessions have been triggered by increases in the short term policy rate (the Fed funds rate). Hence, it is often thought that an inversion of the yield curve presages a recession. In Figure 1, I plot two spreads: (i) the 10 year-3 month spread, and (ii) the 10 year-2 year spread.



**Figure 1:** Ten year-three month spread (blue), and ten year-two year spread (red) and ten year-five year spread (green). NBER defined recession dates shaded gray. Source: St. Louis Fed FRED, and NBER.

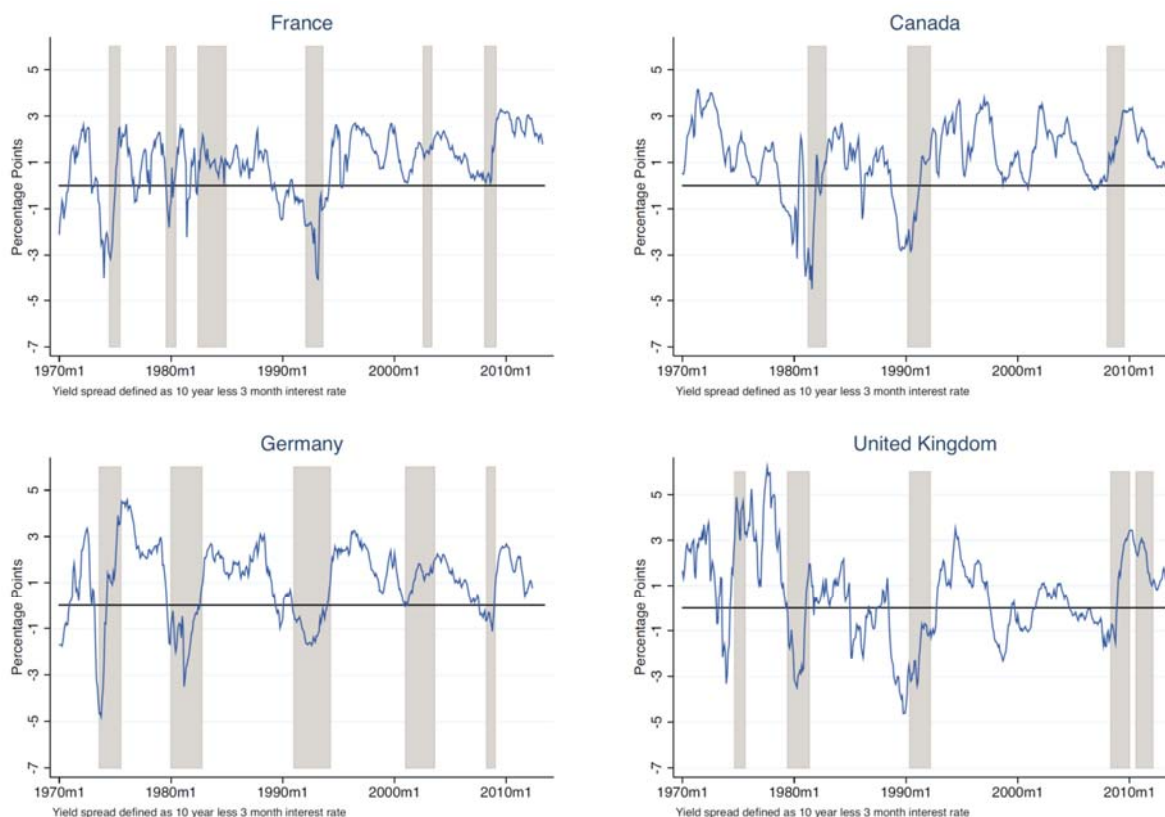
Notice that inversions of the yield curves (when the lines dip below zero, or come close is) often precede recession. There is a large literature which tries to assess whether the relationship between the yield curve and subsequent economic activity (either growth or recession) is robust. A separate, but related, question whether the term premium provides additional information above and beyond that provided by lagged income and other indicators.

A general reading of the literature is the yield curve did have some predictive power, but was declining over time. Wright (2006) argued that the level (namely, the level of the short term interest rate) as well as the slope of the yield curve needed to be included.

### *Cross-country Analysis*

The evidence for predictive power across other countries is less developed; see Chinn and Kucko (2015) for discussion. The graphs analogous to Figure 1, for European countries and Japan. These are reproductions of Figure 1 from Chinn and Kucko (2015).

The graphs are suggestive, but do not confirm the posited relationships. This is why we need regression analysis.



**Figure 1:** Yield curves and recessions: selected countries.

**Table 1: Current Yield Spread as Predictor of Future IP Growth: Full Sample (1970–2013)**

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Neth.	(7) Sweden	(8) UK	(9) US
<b>12-month growth</b>									
Spread	1.81 [0.23]***	1.22 [0.38]***	1.52 [0.30]***	0.85 [0.31]***	1.23 [0.47]***	1.03 [0.27]***	0.99 [0.41]**	0.69 [0.22]***	1.14 [0.22]***
Constant	0.079 [0.65]	-0.022 [0.72]	-0.059 [0.71]	0.84 [0.80]	1.26 [0.95]	0.26 [0.58]	-1.54 [1.02]	0.38 [0.49]	1.71 [0.61]***
$R^2$	0.27	0.13	0.23	0.064	0.068	0.11	0.068	0.11	0.20
Observations	501	507	507	495	507	474	495	507	508
Durbin-Watson	0.142	0.245	0.314	0.272	0.133	0.848	0.351	0.286	0.069
White	0.004	0.031	0.001	0.776	0.813	0.050	0.209	0.738	0.002

**Table 3: Current Yield Spread as Predictor of Future IP Growth: Late Sample (1998–2013)**

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Neth.	(7) Sweden	(8) UK	(9) US
<b>12-month growth</b>									
Spread	1.60 [0.89]	2.45 [1.26]	5.04 [1.40]***	2.57 [1.49]	5.86 [5.92]	1.95 [1.19]	6.04 [1.67]***	0.44 [0.53]	1.19 [0.50]**
Constant	-1.75 [2.27]	-4.49 [2.72]	-4.25 [2.22]	-5.01 [3.00]	-6.74 [8.53]	-0.99 [2.01]	-8.51 [3.00]***	-0.99 [0.78]	-0.38 [1.48]
$R^2$	0.10	0.21	0.46	0.19	0.035	0.13	0.45	0.041	0.14
Observations	165	171	171	171	171	171	171	171	172
Durbin-Watson	0.082	0.202	0.233	0.142	0.152	0.611	0.386	0.178	0.059
White	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002

**Table 5: Current Yield Spread as Predictor of Future Recession: Full Sample (1970–2013)**

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Sweden	(7) UK	(8) US
<b>Next 6 months</b>								
Spread	-0.39 [0.11]***	-0.37 [0.091]***	-0.68 [0.17]***	-0.094 [0.093]	-0.059 [0.095]	-0.29 [0.12]**	-0.067 [0.10]	-0.46 [0.085]***
Constant	-0.73 [0.23]***	-0.43 [0.19]**	0.11 [0.23]	-0.51 [0.19]***	-0.42 [0.18]**	-0.21 [0.19]	-0.68 [0.19]***	-0.64 [0.19]***
R <sup>2</sup>	0.18	0.12	0.34	0.016	0.0045	0.10	0.0094	0.27
Observations	519	519	509	505	519	519	519	519
<b>Next 12 months</b>								
Spread	-0.49 [0.12]***	-0.44 [0.10]***	-0.63 [0.15]***	-0.053 [0.089]	-0.020 [0.099]	-0.29 [0.13]**	-0.11 [0.099]	-0.69 [0.12]***
Constant	-0.50 [0.22]**	-0.14 [0.20]	0.31 [0.24]	-0.36 [0.19]	-0.23 [0.18]	-0.047 [0.19]	-0.51 [0.19]***	-0.29 [0.20]
R <sup>2</sup>	0.24	0.15	0.29	0.0050	0.00051	0.11	0.025	0.38
Observations	519	519	509	505	519	519	519	519

### *Is This Time Different?*

A commonly heard refrain is that this time, the inversion of the yield curve will not predict a recession. The argument is that the 10 year term premium has changed behavior, now becoming negative, rather than positive (as has been posited historically). This phenomenon could be true because of quantitative (more accurately “credit”) easing, or because of the possibility of deflation (as noted by James Hamilton in his presentation).

One can in principle get a “pure” expectations component (first term on right hand side of equation (10)) by subtracting an estimate of the term premium. Doing this yields the top graph in Figure 2 below (the bottom graph is the estimate of  $tp_{10t}$  from the NY Fed, based on the methodology of Adrian, Crump and Moench (2013)).

Notice inversions of the 10yr-3mo term premium adjusted spread are not necessarily always precursors of a recession. Through the 1980s and mid-1990’s, the adjusted spread is negative and no recession follows. Moreover, as of 2019, the adjusted spread has not inverted.

However, there are different estimates of the term premium, and as noted by Chinn (2019), different adjustments lead to different implied probabilities of recession. Using the SF Fed estimate would yield a higher probability of recession than using the NY Fed’s estimate.

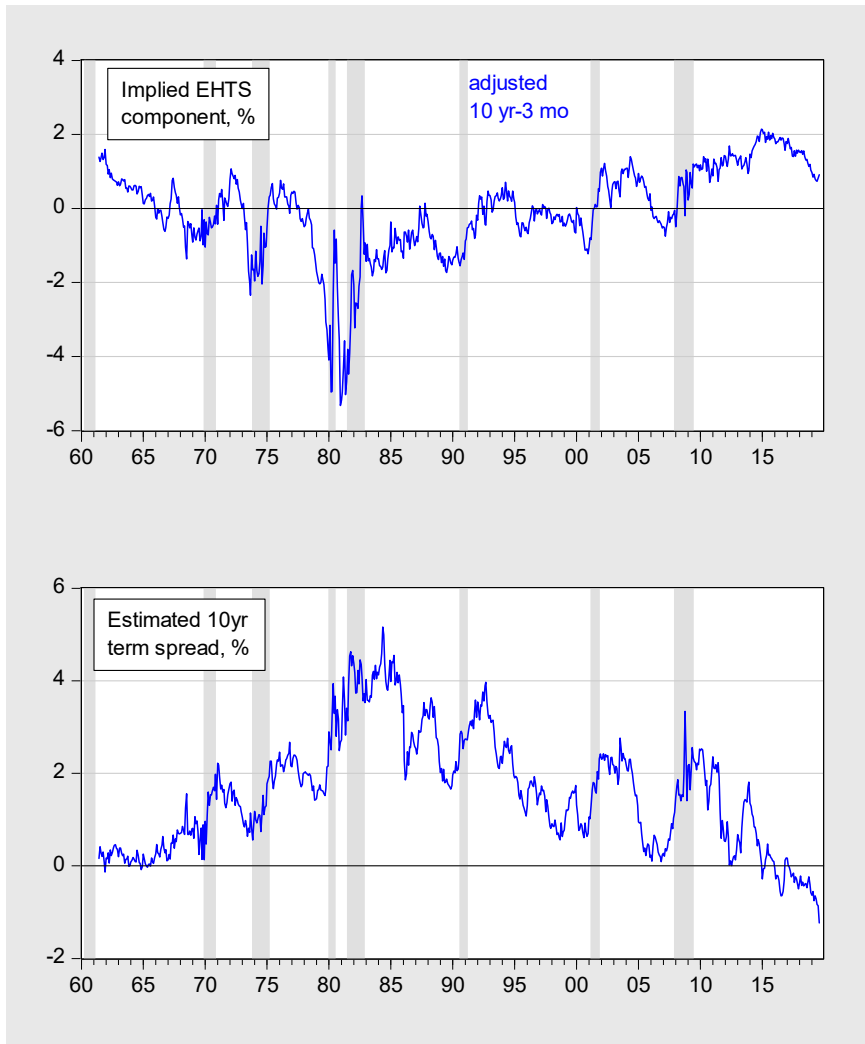
### **References**

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Chinn, Menzie and Kavan Kucko, “The Predictive Power of the Yield Curve across Countries and Time,” *International Finance*, 18(2): 129–262 (Summer 2015).

Wright, Jonathan, “The Yield Curve and Predicting Recessions,” *Finance and Economic Discussion Series* No. 2006-07, Federal Reserve Board, 2006.



**Figure 2:** Top graph: Ten year-three month spread adjusted by estimated ten year term premium. Bottom graph: Ten year estimated term premium. NBER defined recession dates shaded gray. Source: St. Louis Fed FRED, NBER, and NY Fed.