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

Expectations Hypothesis of the Term Structure: Math

If agents are risk neutral.

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

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

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

Rearranging:

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

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

$$P^e_{1t+1} = \frac{\$100}{1+i^e_{1t+1}}$$

This can be substituted into (4) to obtain:

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

We know in fact:

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

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

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

Which implies:

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

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

$$2i_{2t} \approx i^e_{1t+1}+i_{1t}$$

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

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

In general:

$$i_{nt} = \frac{(i_{1t} + i^e_{1t+1} + ... + i^e_{1t+n-1})}{n} \quad (9)$$

The Liquidity Premium Theory of the Term Structure

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

$$i_{nt} = \frac{(i_{1t} + i^e_{1t=1} + ... + i^e_{1t+n-1})}{n} + rp_{nt} \quad (10)$$

Where i_{nt} is the interest rate on a bond of maturity n at time t, i^e_{1t+j} and is the expected interest rate on a one period bond for period $t+j$, based on information available at time t, and rp_{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 $l^n_t > 0$ 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 $rp_{nt} = 0$ (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 $rp_{nt} > 0$, then an inversion should imply a downturn, even more strongly.

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 three spreads: (i) the 10 year-3 month spread, and (ii) the 10 year-2 year spread, and (iii) the 10 year-5 year spread.

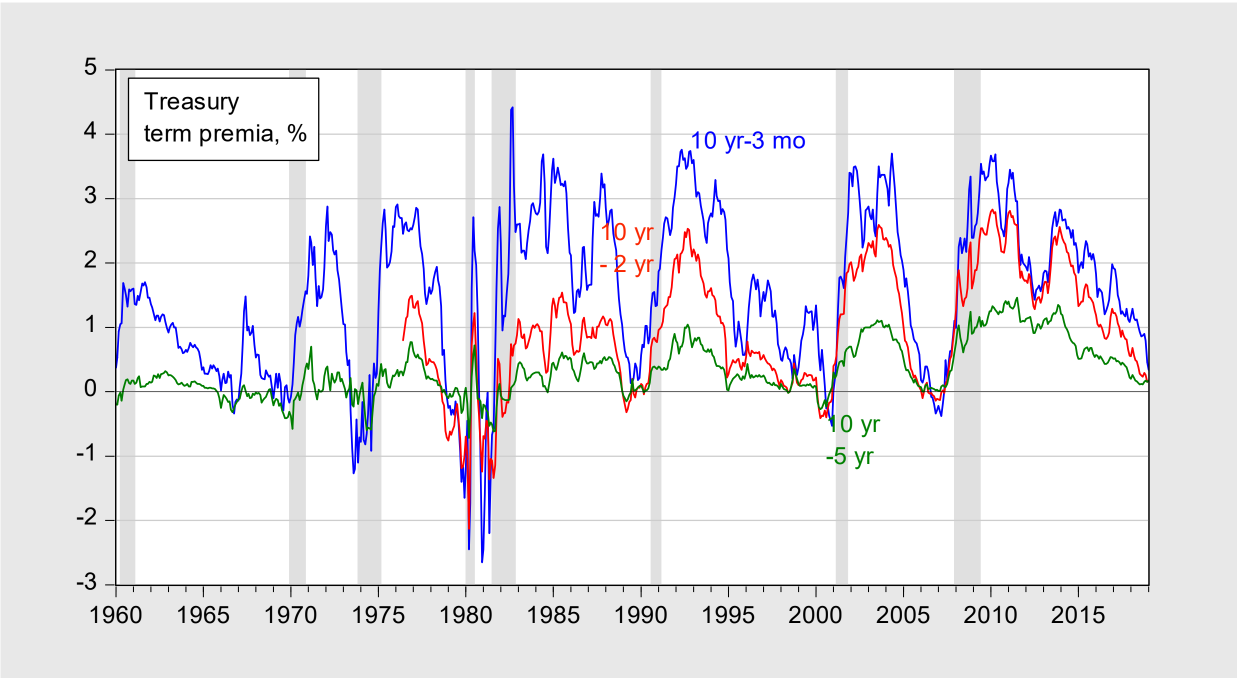

Figure 1: Ten year-three month spread (blue), and ten year-two year spread (red) and ten year-five year spread (green). NBER defined recession dates shaded gray. Source: St. Louis Fed FRED, and NBER.

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 are presented in Figure 2.

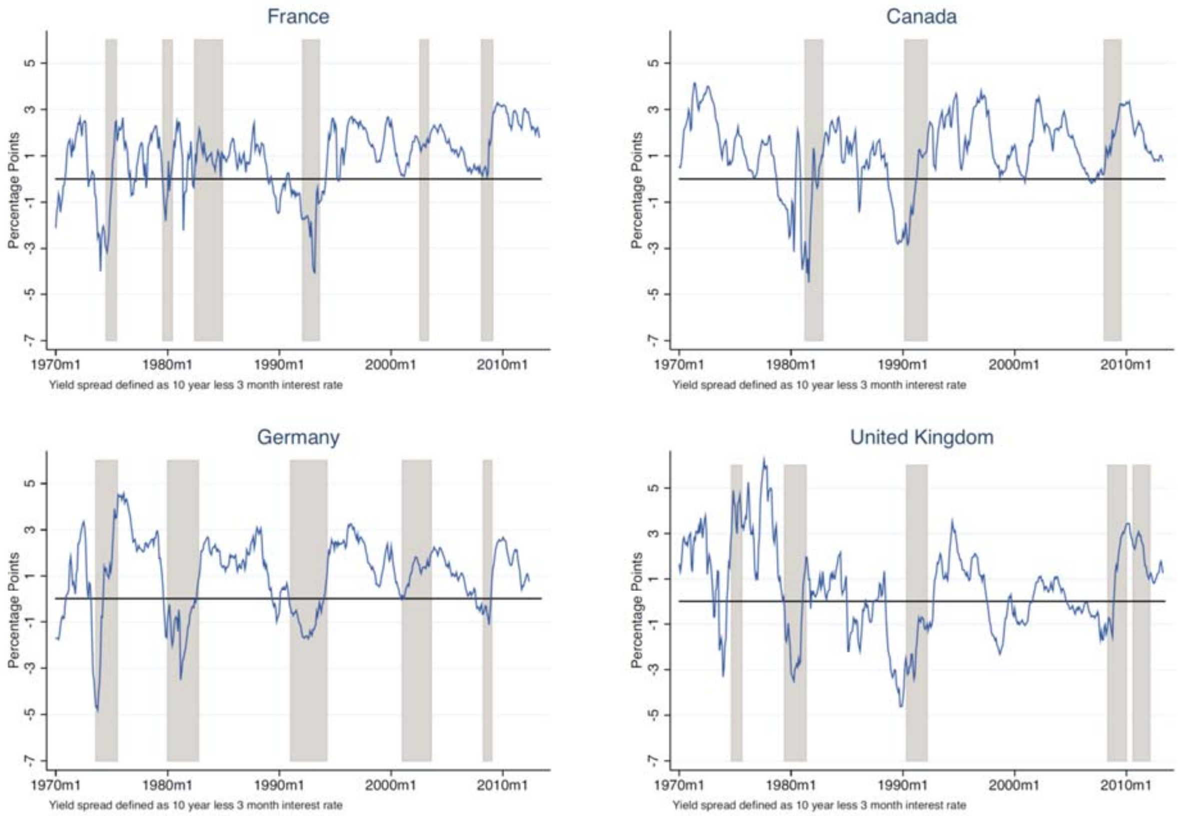

Figure 1: Yield curves and recessions: selected countries.

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

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
12-month growth									
Spread	1.81	1.22	1.52	0.85	1.23	1.03	0.99	0.69	1.14
	[0.23]***	[0.38]***	[0.30]***	[0.31]***	[0.47]***	[0.27]***	[0.41]**	[0.22]***	[0.22]***
Constant	0.079	−0.022	−0.059	0.84	1.26	0.26	−1.54	0.38	1.71
	[0.65]	[0.72]	[0.71]	[0.80]	[0.95]	[0.58]	[1.02]	[0.49]	[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
12-month growth									
Spread	1.60	2.45	5.04	2.57	5.86	1.95	6.04	0.44	1.19
	[0.89]	[1.26]	[1.40]***	[1.49]	[5.92]	[1.19]	[1.67]***	[0.53]	[0.50]**
Constant	−1.75	−4.49	−4.25	−5.01	−6.74	−0.99	−8.51	−0.99	−0.38
	[2.27]	[2.72]	[2.22]	[3.00]	[8.53]	[2.01]	[3.00]***	[0.78]	[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
Next 6 months								
Spread	−0.39	−0.37	−0.68	−0.094	−0.059	−0.29	−0.067	−0.46
	[0.11]***	[0.091]***	[0.17]***	[0.093]	[0.095]	[0.12]**	[0.10]	[0.085]***
Constant	−0.73	−0.43	0.11	−0.51	−0.42	−0.21	−0.68	−0.64
	[0.23]***	[0.19]**	[0.23]	[0.19]***	[0.18]**	[0.19]	[0.19]***	[0.19]***
R^2	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
Next 12 months								
Spread	−0.49	−0.44	−0.63	−0.053	−0.020	−0.29	−0.11	−0.69
	[0.12]***	[0.10]***	[0.15]***	[0.089]	[0.099]	[0.13]**	[0.099]	[0.12]***
Constant	−0.50	−0.14	0.31	−0.36	−0.23	−0.047	−0.51	−0.29
	[0.22]**	[0.20]	[0.24]	[0.19]	[0.18]	[0.19]	[0.19]***	[0.20]
R^2	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

References

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.

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