

# **EC247 FINANCIAL INSTRUMENTS AND CAPITAL MARKETS**

## **TERM PAPER**

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**Term Paper Title:**

**Explain what is meant by the term structure of interest rates. Critically evaluate the different theories that have been evolved to account for the various shapes of the term structure.**

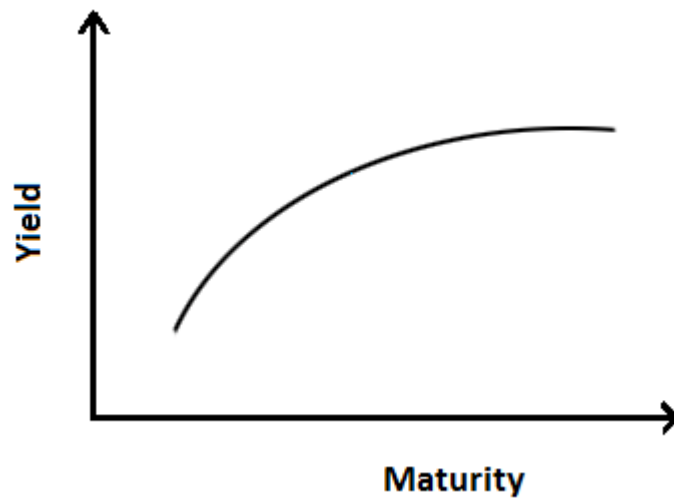
Interest rate is defined as the cost of borrowing funds or the price paid for the rental funds. The most accurate measure of interest rates is the yield to maturity and financial economists take that into consideration when they use the term interest rate. Moreover, interest rates are crucial tools in the financial market and therefore are closely and carefully watched on a daily basis. They play a key role in a bond's valuation process and therefore are directly linked with its price. The meaning of term structure and the different theories that concern the various shapes of it are the main points that will concern us in the following study.

It is reasonable to think that if identical bonds have different terms to maturity then their interest rates will differ. The term structure of interest rates is defined as the relationship between the yields on bonds with different maturities and considers all other factors which affect the interest rates such as risk, tax and liquidity as identical. The yield curve is also directly linked with the term structure concept and graphically represents the yields on bonds of the same credit quality but with different maturities. In previous years, most investors used the Treasury market to construct yield curves by observing its prices and yields.

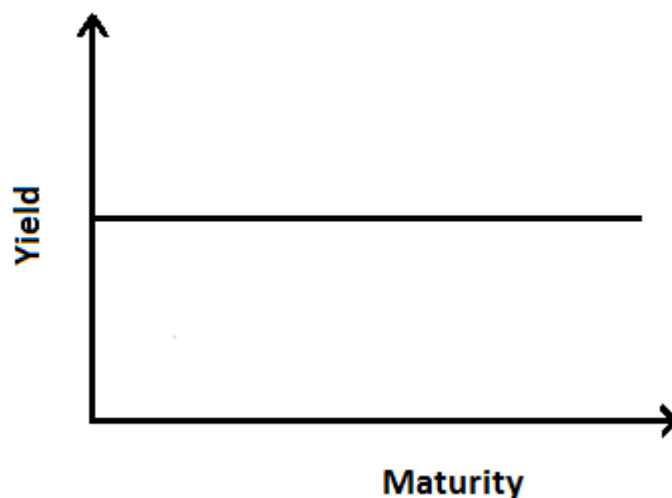
Treasuries issued by the government are considered risk-free; hence their yields are often used as the benchmarks for fixed-income securities with the same maturities. The term structure of interest rates is graphed as though each payment of a non-callable fixed-income security were a zero coupon bond that "matures" on the coupon payment date. The shape of the yield curve – which differs at each point of time - is believed to reflect the market's future expectations for interest rates and monetary policy and this is useful for economists and investors.

The three main patterns created by the term structure of interest rates are the following:

- 1) Normal Yield Curve;** This yield curve shape is formed during normal market conditions, where no significant changes in the economy are expected to take place such as in inflation rates, and also the economy will continue to grow at a normal rate. During these conditions, the market expects long-term fixed-income securities to offer higher yields than short-term fixed-income securities. This is considered to be a normal expectation since short-term instruments bear less risk than long-term instruments; the farther into the future a bond matures, the more uncertainty the bondholder faces before being paid back the principal. To invest in one instrument for a long period of time an investor must be compensated for undertaking the additional risk. Therefore this normal yield curve is thought to reflect the higher inflation-risk premium that investors demand for long-term bonds. In general if current interest rates increase, the price of a bond will decrease and its yield will increase.



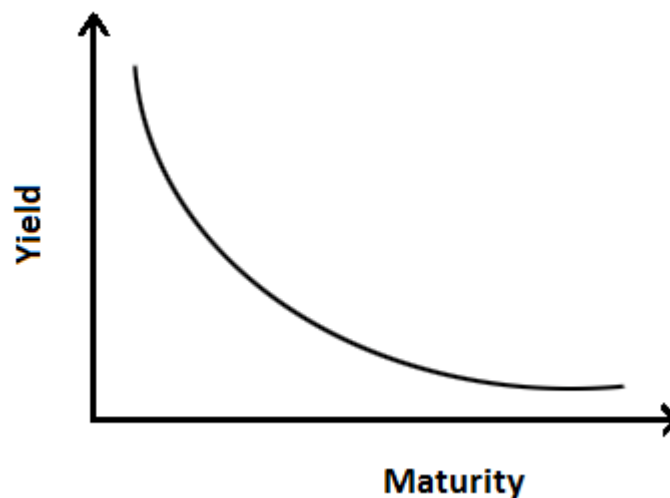
- 2) **Flat Yield Curve:** This yield curve shape generally implies that the short-term rates will equal the long-term rates. In such conditions it is difficult for the market to determine whether interest rates will move in either direction in the future. A flat yield curve usually occurs when the market is making a transition that shows different but simultaneous indications of what interest rates will do. What we mean is that there may be some signals that short-term rates will raise and other signals that long-term rates will fall. This condition will create a curve that is flatter than its normal positive slope. When the yield curve is flat, investors can maximize their risk-return trade-off by choosing fixed-income securities with the least risk, or highest credit quality.



### **3) Inverted Yield Curve:**

These yield curves are rare, and they form during unusual market conditions where the expectations of the investors are completely the opposite of those demonstrated by the normal yield curve. Under this contradictory situation, investors expect bonds with longer maturity to offer lower yields than bonds with shorter maturities. This inverted yield curves indicates that the market currently expects interest rates to decline in the future which consequently means that the market expects yields of long-term bonds to decline. As interest rates decrease, bond prices increase and yields decline.

The concept of risk premium states that investors would demand a compensation for taking on more risk when investing in long-term instruments. But in the case of an inverted yield curve, why would investors choose to purchase long-term fixed-income investments when they expect to receive less compensation for taking on more risk? The answer is that some investors interpret this inverted yield curve as an indication that the economy will soon experience a slowdown, which causes future interest rates to give even lower yields. Hence they want to lock their money into long-term instruments before the yields are driven even more down.



A drawback of the basic yield curve is that it does not take into consideration securities that have varying coupon rates. Therefore it is necessary to develop a more accurate estimate of the Treasury yield curve. By the following approach we will be able to identify yields that apply to zero-coupon bonds and therefore eliminate the problem of coupon rate differences in the yield-maturity relationship. For example if we had to compare a 10-year bond paying a 6% coupon with a 10-year Treasury bond that currently has a coupon of 3% our comparison would not be very accurate. Therefore, a more accurate measure would be the spot rate; this is the yield on a zero-coupon Treasury which help us to determine the value of each zero-coupon instrument with the same maturity. The graphical representation of the relationship between the spot rate and the maturity is called the spot rate curve.

These two terms are used together to determine the value of each zero-coupon component of a non-callable fixed-income security. Using the theoretical spot rate curve we assume that the term structure of interest rates is graphed as though each coupon payment of a non-callable fixed-income security were a zero-coupon bond. The term structure of interest rates is a measure of the direction of interest rates and the general state of an economy. Since corporate fixed-income securities have more risk of default than Treasury securities, the prices of corporate securities are usually lower while carrying higher yields.

In the text above, we have seen the different shapes that a yield curve can take. It can either be upward sloping, downward sloping or flat. An upward sloping yield curve implies that the long-term interest rates are above the short-term interest rates, i.e. yields rise steadily as maturity increases. When the yield curve is downward sloping long-term interest rates are expected to be below short-term interest rates. Finally a flat yield curve denotes that short-term and long-term rates are the same. These are the most usually observed shapes of yield curves. There are cases however, where yield curves can be humped and this happens when the relationship between interest rates and a bond's term to maturity is not linear. But what actually determines the different shapes of a yield curve? While trying to find the answer to that, we must take into account the following empirical facts that a good theory of the term structure of interest rates must incorporate;

- a)** Interest rates on bonds of different maturities move together over time
- b)** When short-term interest rates are low, yield curves are usually upward sloping; when short-term interest rates are high, yield curves are usually downward sloping and inverted
- c)** Generally yield curves tend to be upward sloping.

In order to explain the term structure of interest rates there are four well-known theories that can be considered. These are; (i) Expectations theory, (ii) Market segmentation theory, (iii) Liquidity theory, and (iv) Preferred Habitat theory each of which will be analysed in the next part. The expectations theory can successfully explain the first two empirical facts but not the third. The market segmentation theory can explain only the third fact. Since each of the two theories explains facts that the other cannot, we have to combine the two to get another theory that can explain all three empirical facts. This will lead us to the liquidity premium theory which is a combination of the features of the other two. Finally, the preferred habitat theory is closely related to the liquidity theory.



$$i_{nt} = \frac{i_t + i_{t+1}^e + i_{t+2}^e + \dots + i_{t+(n-1)}^e}{n}$$

In different means, the n-period interest rate is equal to the average of the one-period interest rates expected to occur over the n-period life of the bond. This is what the expectations theory tells us in more accurate terms.

We can now use a numerical example using the general equation we have already seen. Let's assume that the one-year interest rate over the next five years is expected to be 4, 5, 6, 7 and 8% respectively. We can easily get that the interest rate on the one-year bond is 4%.

For the two-year bond we get;  $\frac{4\%+5\%}{2} = 4.5\%$

For the three-year bond;  $\frac{4\%+5\%+6\%}{3} = 5\%$

For the four-year bond;  $\frac{4\%+5\%+6\%+7\%}{4} = 5.5\%$

For the five-year bond;  $\frac{4\%+5\%+6\%+7\%+8\%}{5} = 6\%$

It is obvious that when the short-term interest rates are expected to rise in the future then the outcome is an upward sloping yield curve (a positive yield curve). In the case that long-term interest rates are currently above the short-term rates, the average of future short-term rates is expected to be higher than the current short-term rate. If the yield curve slopes downwards, the average of future short-term interest rates is expected to fall. The only case where the future short-term rates are expected to remain unchanged is when the yield curve is flat.

Now we can understand why this theory explains empirical facts one and two but not the third one. According to the first fact, interest rates on bonds with different maturities move together over time. An increase in short-term interest rates tends to be higher in the future. Therefore if short-term rates rise, then people's expectations regarding future interest rates will also rise. Since here we consider long-term rates to be the average of expected future short-term rates, a rise in short-term rates will also raise long-term rates causing the two to move together over time.

The second fact states that yield curves are upward sloping when short-term interest rates are low and are downward sloping when short-term interest rates are high. If there is the case that short-term rates are low, market participants expect them to rise to a normal level in the future and the future expected short-term rates, on average, is higher relative to the current short-term rate. The yield curve then slopes upwards since long-term interest rates will be much higher than current short-term rates. On the other hand, if the short-term interest rates are high, people expect them to come down. The yield curve will then come down and be inverted since long-term rates will drop below short-term rates as the average of expected future short-term rates will be lower than current short-term rates.

Another fact that can be explained through this theory about short-term and long-term rates is that interest rates are mean-reverting. This means that they tend to return to their normal levels if they experience an unusual rise or fall. This leads to the conclusion that short-term rates are more volatile than long-term rates.

One disadvantage of this theory is that it fails to explain fact three which states that yield curves usually slope upwards. Typically the expectations theory is more closely related to a flat yield curve since short term rates are just as likely to fall as they are to rise.

### Market Segmentation theory:

In this theory, markets for different maturity bonds are considered to be completely segmented, separated and cannot be commutable. Therefore, the interest rate for each bond with different maturity is determined by the supply of and demand for that particular bond since they are not substitutes. Borrowers have specific investment preferences, meaning that they have particular periods they want to borrow and lenders have particular holding periods in mind. A main assumption of this theory is that bonds of different maturities *are not perfect substitutes*, therefore investors will only consider the expected returns on bonds whose maturity interests them. The choice that investors have to make is whether they prefer short-term to long-term instruments. Empirically we know that investors prefer short-term instruments since they are more liquid and also because they carry less risks. This leads to a higher demand in the market for short-term instruments which will cause higher prices and lower yield. Hence the yield on long-term bonds will be higher and this explains why the yield curve is upward sloping.

Here we have concluded that market segmentation theory explains the third empirical fact but it does not explain the other two. Since markets for different maturity bonds are segmented it cannot be the case that short-term and long-term bonds move together, and for the same reasoning it cannot explain why short-term yields are more volatile than long-term yields.

### Liquidity Premium Theory:

In order to find a theory which can explain all three facts, we combine the previous two theories and create a new one which is called the Liquidity premium theory.

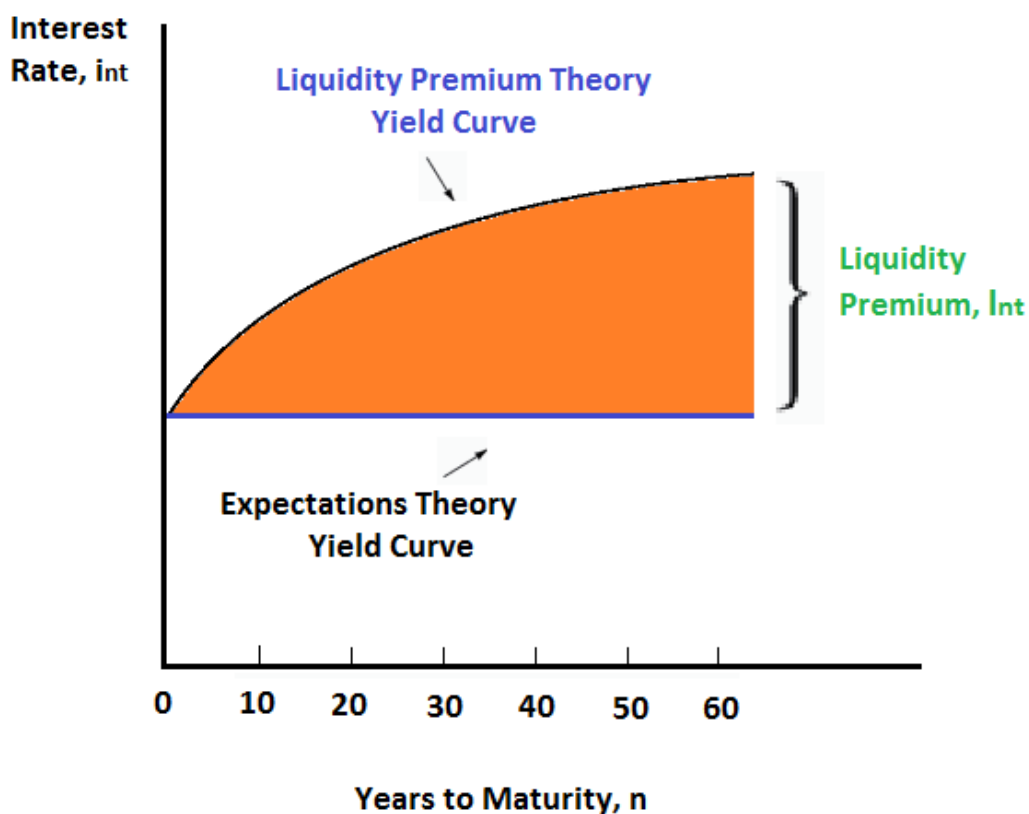
This new theory states that the interest rate on a long-term bond will equal an average of short-term interest rates expected to occur over the life of the long-term bond plus a liquidity premium (Mishkin and Eakins, 2012, p.143). It is a fact that all kind of bonds can be risky since there is uncertainty about inflation and future interest rates. What bondholders look into is the purchasing power of the return – the real return – they receive from bonds not just how much they will get from the coupon payments. If there is uncertainty about the level of inflation then there will be uncertainty about a bond's real return, making the investment a risky one. The longer the maturity of a bond, the higher is the uncertainty since the harder is to estimate the level of inflation. The interest rate risk arises from a mismatch between an investor's investment horizon and a bond's time to maturity. If an investor decides not to hold a bond until it matures but sell it beforehand then any changes in the interest rate (which ultimately will cause the bond's price to change) generates capital gains or losses. The longer the term to maturity the more volatile the price of a bond will be



according to changes in the interest rates and therefore the higher the risk of potential losses. Moreover, the buyer of a long-term bond will require compensation for the risks he undergoes when purchasing long-term bonds instead of short-term bonds. The key assumption in this theory is that bonds of different maturities are substitutes, which means that the expected return on one bond does influence the expected return on a bond with a different maturity but despite the expectations theory, they **are not perfect substitutes** something that allows investors to prefer one bond maturity over another. Here, investors require a positive liquidity premium in order to engage their money in long-term instruments and bear the risk. The yield in this case has two parts; the first one is the same like in the expectations theory which is risk-free, and the second one is the positive liquidity premium for investing in the long-term bond. Thus, the yield on an ***n*-year** bond will be;

$$i_{nt} = \frac{i_t + i_{t+1} + i_{t+2} + \dots + i_{t+(n-1)}}{n} + l_{nt}$$

Since in this theory the liquidity premium is always positive and typically grows larger as the term to maturity increases, the yield curve in this theory is always above the yield curve depicted from the expectations theory and in general has a steeper slope.



### Preferred Habitat Theory:

This theory is an offshoot of the liquidity premium theory which means that investors take into consideration both expected returns and maturity. However, they have a preference on which bond they would like to invest according to that particular bond's maturity. In order for investors to invest in bonds which do not have the desirable maturity they would require a higher expected return on those bonds.

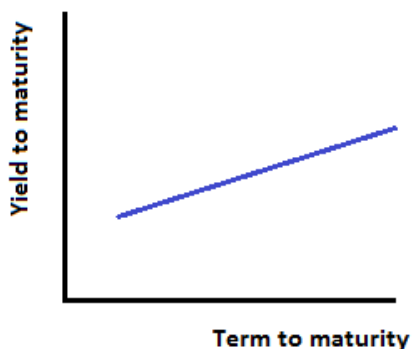
Specifically, investors can trade outside their preferred maturity if they receive a risk premium for investing in bonds with non-preferable maturity. A notable fact is that market participants usually prefer short-term bonds to long-term bonds and they would never choose a long-term bond that gives them the same interest rate with a short-term bond.

### Which one of these theories is the best?

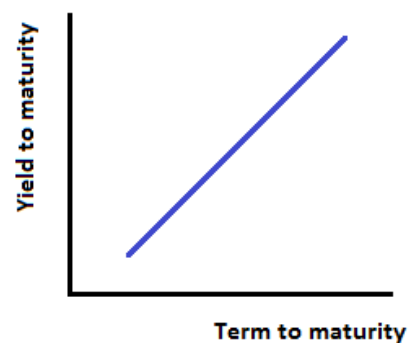
If we want a theory that adjusts with the daily changes in the term structure then we would prefer the Preferred Habitat Theory. But if we want to look into long-run decisions then the expectations and liquidity theory will be more applicable.

### Interpreting Yield Curves:

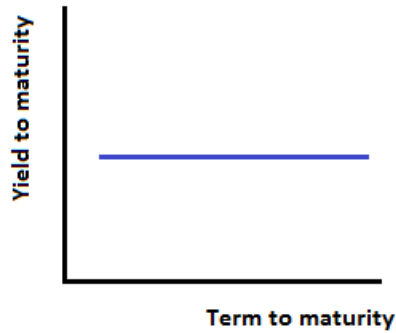
- If the yield curve slopes slightly upwards, interest rates are expected to stay the same in the future.
- If the yield curve slopes sharply upwards, short-term rates are expected to rise.
- If the yield curve is flat, short-term interest rates are expected to fall only slightly.
- If the yield curve slopes downwards, short-term interest rates are expected to decline sharply.



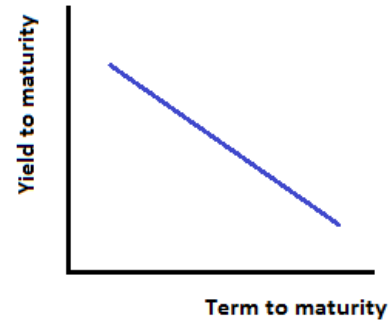
**Short-term interest rates  
expected to stay the same**



**Short-term interest rates  
expected to rise in the  
future**



**Short-term interest rates  
expected to fall slightly**



**Short-term interest rates  
expected to decline sharply**

Rising interest rates are often linked with economic booms and falling interest rates with recessions. When there is a slight fall or downward sloping of yield curves, short-term interest rates are expected to fall and this is interpreted as going into a recession.

In conclusion, in this study I started from the basics explaining interest rates, yield curves and then went on to the term structure and the four main theories that reflect the different shapes of the term structure. I have looked into the different theories separately and examined their functions and stating the facts each one satisfies. Therefore, our main conclusion is that interest rates in general and the term structure can provide useful information to market participants and help them to forecast events in the economy in order to adjust their policies.

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