

Interest Rates: Term Structure and Theories

Michael Gorun
Jawad Ahmed

What is Interest?

- In Economics, interest is simply the price of money
- Who pays and collects interest?
 - Governments
 - National
 - Local
 - Corporations
 - Non-Profits
 - Private Citizens

Interest-ING Examples

	1 MONTH CURRENT	1 MONTH PRIOR	3 MONTH PRIOR	6 MONTH PRIOR	1 YEAR PRIOR
Federal Reserve Target Rate	4.5	4.75	5.25	5.25	5.25
1-Month Libor	4.69	5.04	5.57	5.32	5.32
3-Month Libor	4.9	5.21	5.52	5.36	5.37
Prime Rate	7.5	7.75	8.25	8.25	8.25
5-Year AAA Banking & Finance	4.78	5.19	5.21	5.13	5.12
10-Year AAA Banking & Finance	5.44	5.71	5.72	5.44	5.36

Supply and Demand Analysis

- One of the best ways to understand how market forces determine interest rates is to use fundamental supply and demand analysis.
- Given:
 - one-period, zero-coupon bond paying a principal of 100 at maturity and priced at P_0 to yield a rate i .
- We want to determine the important factors that determine its supply and demand.

Bond Demand and Supply Analysis

Bond Demand Curve:

- Bond Demand Curve: The curve shows an inverse relationship between, bond demand, B^D , and its price, P_0 , and a direct relation between B^D interest rate, i , given other factors are constant.
- Bond demand curve is also called the supply of loanable funds curve.

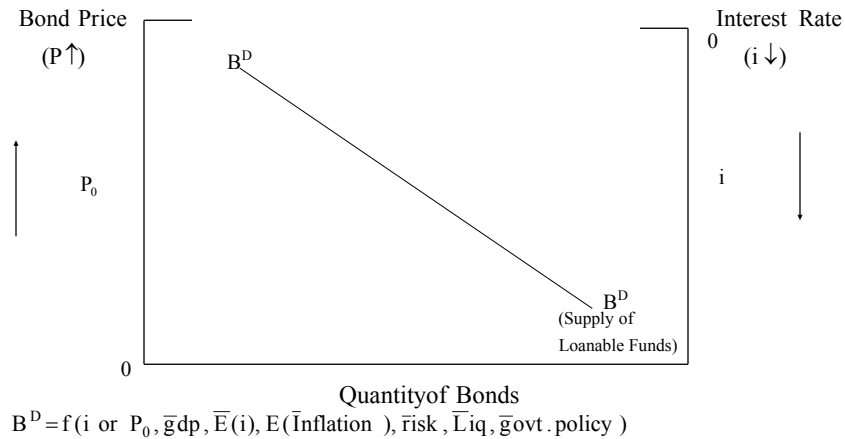
Bond Demand and Supply Analysis

Bond Demand Curve:

- The factors held constant include the overall wealth or economic state of the economy, as measured by real output, gdp, the bond's risk relative to other assets, its liquidity relative to other assets, expected future interest rates, $E(i)$ and inflation, and government policies:

$$B^D = f(i \text{ or } 1/P_0, \bar{gdp}, \bar{E}(i), E(\bar{Inflation}), \bar{risk}, \bar{Liq}, \bar{govt. policy})$$

- Bond Demand Curve



Bond Demand and Supply Analysis

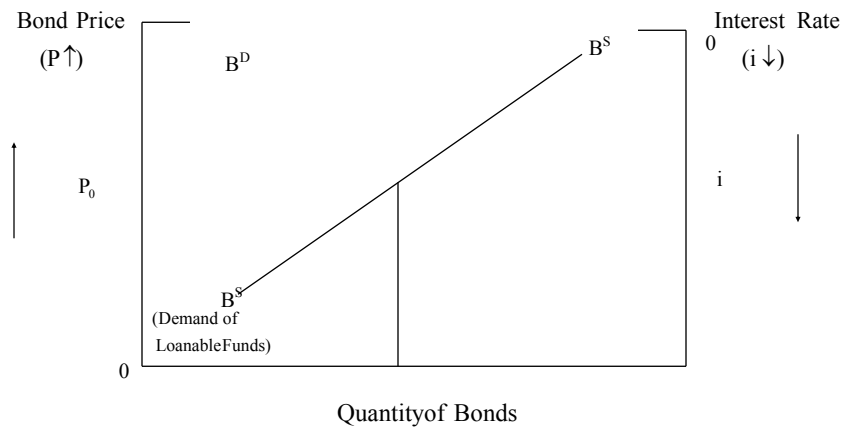
Bond Supply Curve:

- The bond supply curve shows the quantity supplied of bonds, B^S , by corporations, governments, and intermediaries is directly related to the bond's price and inversely related interest rate, given other factors such as the state of the economy, government policy, and expected future inflation are constant:

$$B^S = f(1/i \text{ or } P_0, \bar{gdp}, \bar{E}(\text{Inflation}), \bar{\text{govt. policy}})$$

- Bond supply curve is also called the demand of loanable funds curve.

- Supply Curve for Bonds



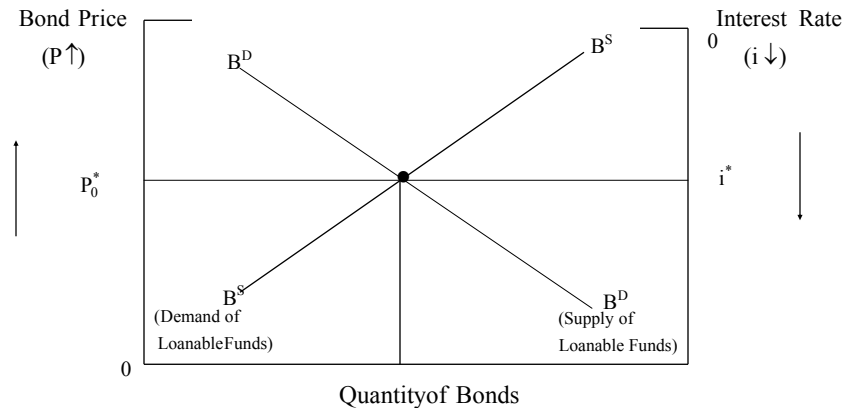
$$B^S = f(i \text{ or } P_0, \bar{gdp}, \bar{E}(\text{Inflation}), \bar{govt. policy})$$

Bond Demand and Supply Analysis

Equilibrium:

- The equilibrium rate, i^* and price, P_0^* , are graphically defined by the intersection of the bond supply and bond demand curves.

- Supply and Demand for Bonds



$$B^D = f(i \text{ or } P_0, \bar{gdp}, \bar{E}(i), E(\bar{\text{Inflation}}), \bar{risk}, \bar{Liq}, \bar{govt. policy})$$

$$B^S = f(i \text{ or } P_0, \bar{gdp}, \bar{E}(\text{Inflation}), \bar{govt. policy})$$

Term Structure of Interest Rates

- Term Structure examines the relationship between YTM and maturity, M.
- Yield Curve: Plot of YTM against M for bonds that are alike.

Term Structure of Interest Rates

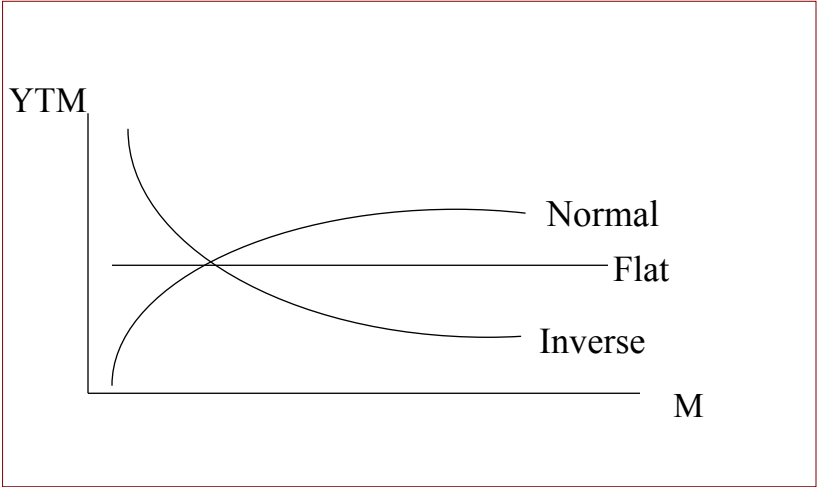
- A yield curve can be constructed from current observations. For example, one could take all outstanding corporate bonds from a group in which the bonds are almost identical in all respects except their maturities, then generate the current yield curve.
- For investors who are more interested in long-run average yields instead of current ones, the yield curve could be generated by taking the average yields over a sample period (e.g., 5-year averages) and plotting these averages against their maturities.
- Finally, a widely-used approach is to generate a spot yield curve from spot rates.

Term Structure of Interest Rates

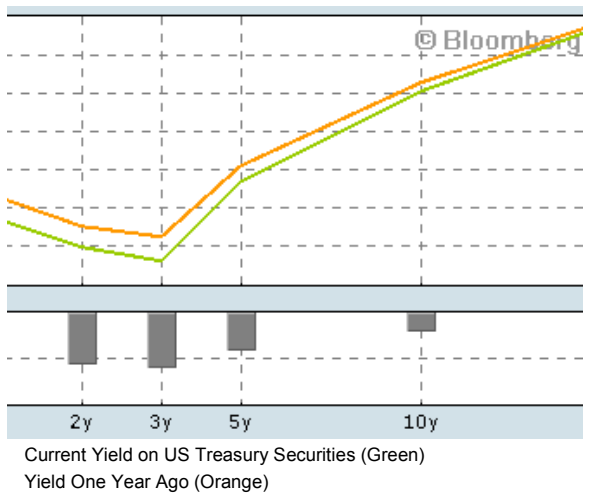
Shapes: Yield curves have tended to take on one of the three shapes:

1. They can be positively-sloped with long-term rates being greater than shorter-term ones.
 - Such yield curves are called **normal** or **upward sloping curves**. They are usually convex from below, with the YTM flattening out at higher maturities.
2. Yield curves can also be negatively-sloped, with short-term rates greater than long-term ones.
 - These curves are known as **inverted** or **downward sloping yield curves**. Like normal curves, these curves also tend to be convex, with the yields flattening out at the higher maturities.
3. Yield curves can be relatively flat, with YTM being invariant to maturity.

Term Structure of Interest Rates

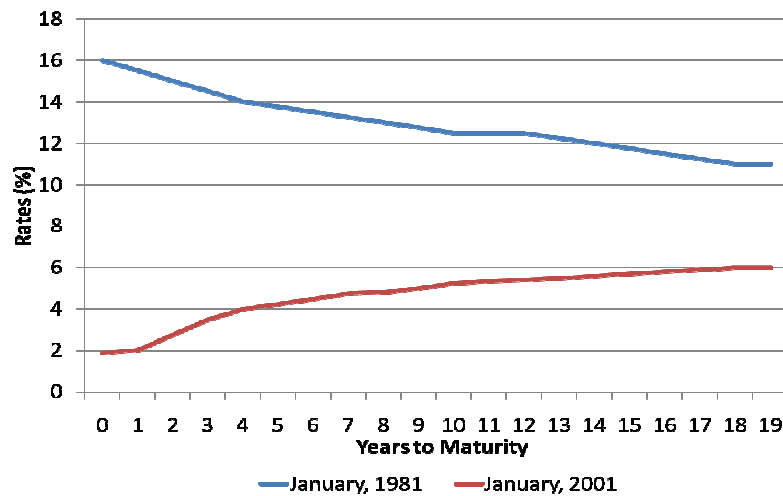


Current Yield Curve



Current Yield on US Treasury Securities (Green)
Yield One Year Ago (Orange)

Historical Interest Rate Spreads Yield Curves

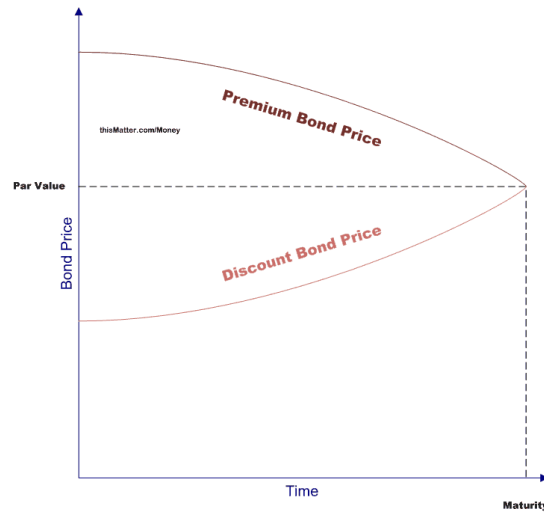


Theories of the Term Structure of Interest Rates

Four theories have evolved over the years to try to explain the shapes of yield curves:

1. Market Segmentation Theory (MST)
2. Preferred Habitat Theory (PHT)
3. Liquidity Premium Theory (LPT)
4. Pure Expectation Theory (PET)

Interest Rates and Fixed Income



Duration

The standard definition of duration:

$$D = \sum_{i=1}^n \frac{P(i)t(i)}{V}$$

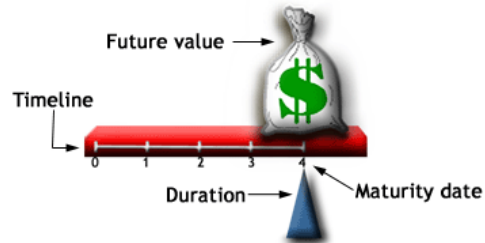
Where $P(i)$ is the [present value](#) of coupon i , $t(i)$ is the future payment date, V is the bond Price and D is the duration.

What is the duration of a zero-coupon bond that matures in 7 years?

What if it is an interest-bearing bond?

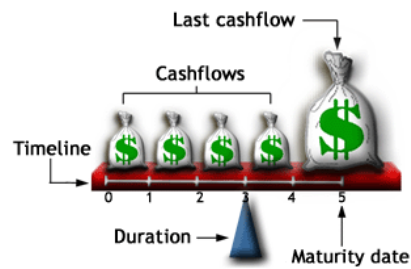
Duration

Duration of a zero-coupon bond:

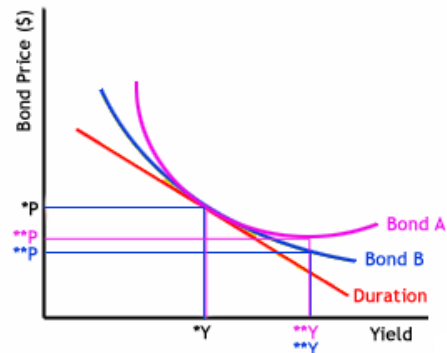


Duration

- Duration of a Vanilla Bond



Convexity



Market Segmentation Theory

- MST: Yield curve is determined by supply and demand conditions unique to each maturity segment.
- MST assumes that markets are segmented by maturity.

Market Segmentation Theory

- Example: The yield curve for high quality corporate bonds could be segmented into two markets:
 - short-term
 - long-term

Preferred Habitat Theory (PHT)

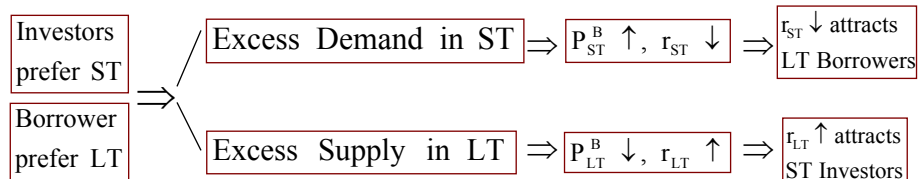
- PHT assumes that investors and borrowers are willing to give up their desired maturity segment and assume market risk if rates are attractive.
- PHT asserts that investors and borrowers will be induced to forego their perfect hedges and shift out of their preferred maturity segments when supply and demand conditions in different maturity markets do not match.

Preferred Habitat Theory (PHT)

- PHT is a necessary extension of the MST:
 - If an economy is poorly hedged (e.g., more investors want ST investments and more borrowers want to borrow LT), then the market will not be in equilibrium.
 - In such cases, ST and LT rates will change and the markets will clear as investors and borrowers give up their hedge.

Preferred Habitat Theory

- Poorly Hedged Economy: Investors, on average, prefer ST investments; corporate borrowers, on average, prefer to borrow LT (sell LT corporate bonds):



Liquidity Preference Theory

- Long-term bonds are more price sensitive to interest rate changes than short-term bonds. As a result, the prices of long-term securities tend to be more volatile and therefore more risky than short-term securities.
- The **Liquidity Premium Theory** (LPT), also referred to as the **Risk Premium Theory** (RPT), posits that there is a liquidity premium for long-term bonds over short-term bonds.

Liquidity Preference Theory

- According to LPT, if investors were risk averse, then they would require some additional return (liquidity premium, LP) in order to hold long-term bonds instead of short-term ones.

$$LP = r_{LT} - r_{ST} > 0$$

Pure Expectations Theory

- Expectation theories address the question of what impact expectations have on the current yield curve.
- One of these theories is the Pure Expectations Theory (PET); also referred to as the unbiased expectations theory (UET).
- PET posits that the yield curve is governed by the condition that the implied forward rate is equal to the expected spot rate.