Review of Fixed-Income Securities

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Introduction

Preliminaries

- Language
- Self-introduction
- Zoom interactions
- Requirements (syllabus)
- Synchronous session recordings and class resources

Introduction

What is a fixed-income security?

Introduction

Definition: Fixed-Income Security

A **fixed-income security** is an investment that provides a return in the form of fixed periodic interest payments and the eventual return of principal at maturity.

Examples

- Coupon-bearing bonds
- Zero-coupon bonds
- Treasury bills
- Treasury bonds
- Certificates of deposit
- Preferred stocks

Introduction

Features of a Bond

1. Bond Issuer
2. Maturity Date
3. Par Value
4. Coupon Rate and Frequency
5. Currency

Introduction

Features of a Bond

1. **Bond Issuer**
   - Usually corporations and governments
2. Maturity Date
3. Par Value
4. Coupon Rate and Frequency
5. Currency

Introduction

Features of a Bond

1. Bond Issuer
2. **Maturity Date**
   - Date on which the principal is to be repaid
   - The time remaining until maturity is referred to as the **term to maturity** or **tenor** of a bond
3. Par Value
4. Coupon Rate and Frequency
5. Currency

Introduction

Features of a Bond

1. Bond Issuer
2. Maturity Date
3. **Par Value**
   - The principal amount that will be repaid at maturity
   - Aka face value, maturity value, redemption value, principal value
   - If bond price > par value: bond selling at a **premium**
   - If bond price = par value: bond selling at **par**
   - If bond price < par value: bond selling at a **discount**
4. Coupon Rate and Frequency
5. Currency

Introduction

Features of a Bond

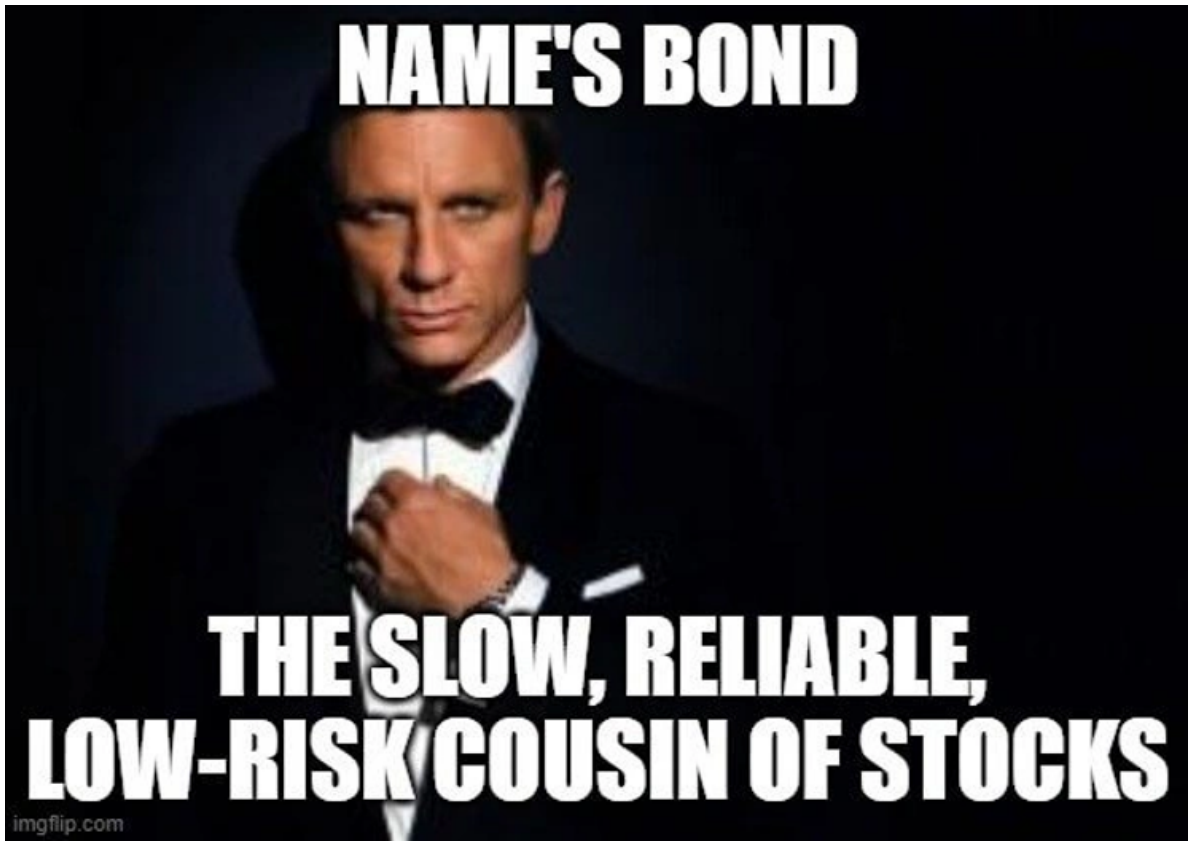
1. Bond Issuer
2. Maturity Date
3. Par Value
4. **Coupon Rate and Frequency**
   - Coupon rate: annual percentage of par value paid to bondholders
   - Frequency: annual, semiannual, quarterly, monthly
   - Fixed coupon rate: **plain vanilla bond**
   - No interest prior to maturity: **zero-coupon bond**
5. Currency

Introduction

Features of a Bond

1. Bond Issuer
2. Maturity Date
3. Par Value
4. Coupon Rate and Frequency
5. **Currency**

Introduction



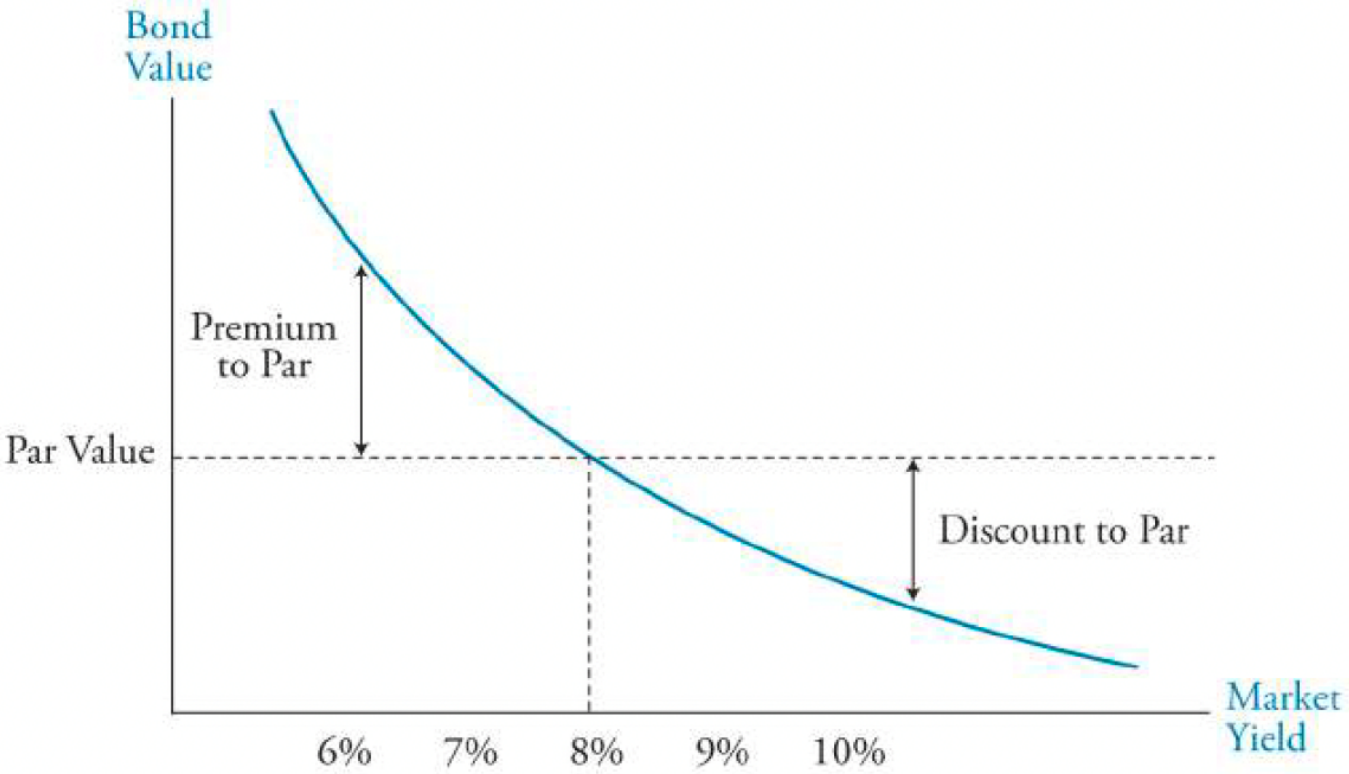
Bond Valuation

The price of a bond can be calculated by summing the **present values** of all the bond's promised cash flows.

The market discount rate appropriate for discounting a bond's cash flows is called the bond's **yield-to-maturity (YTM)**.

Bond Valuation

Figure 1: Market Yield vs. Bond Value for an 8% Coupon Bond



Bond Valuation

Graph Observations

- Inverse relationship between YTM and bond price
- Selling at premium/par/discount (same compounding frequency)
- Convexity

Bond Valuation

Example

Suppose today is October 12, 2021. A 10-year corporate bond has $1,000 par value, 10% coupon rate with interest paid annually, and maturity date on December 31, 2025. If the prevailing market yield for the bond is 11% compounded continuously, what is the current price of the bond? Use the actual/360 day-count convention.

Bond Valuation

Bond Valuation: Things to Watch Out For

1. Frequency of coupon payments
2. Compounding frequency of the yield
3. Day-count convention

Duration and Other Concepts

What are zero rates?

Duration and Other Concepts

Recall: Zero Rates

When we have the YTM, we use the same discount rate for every cash flow. In reality, however, this rate is not readily available, and discount rates depend on the time period in which the cash flow will arrive.

These varying discount rates are called **spot rates/zero rates**.

We can think of zero rates as the YTMs of zero-coupon bonds.

Duration and Other Concepts

What are basis points?

Duration and Other Concepts

Recall: Basis Points

1 basis point (bp) = 0.01%

Duration and Other Concepts

What is a bond's Macaulay Duration? Modified Duration?

Duration and Other Concepts

Recall: Macaulay Duration

The **Macaulay duration** of a bond is given by

$$D = \sum_{i=1}^{n} \frac{t_i}{P} CF_i e^{-yt_i},$$

where CF_i is the cash flow at time t_i,
P is the bond price, and
y is the bond's YTM

The Macaulay duration can be interpreted as the weighted average amount of time until cash flows arrive.

Duration and Other Concepts

Recall: Modified Duration

The **modified duration** of a bond is given by

$$D^* = -\frac{1}{P}\frac{\partial P}{\partial y},$$

where P is the bond price and
y is the bond's YTM

The modified duration is used to determine the effect of interest rate changes to the bond price.

Duration and Other Concepts

Notes on Duration

1. If the yield is continuously compounded, then $D^* = D$.
2. If the yield is **not** continuously compounded, then

$$D^* = \frac{D}{1 + \frac{y}{m}}$$

Notes on Duration

Let's prove 1.

Duration and Other Concepts

What is DV01?

Duration and Other Concepts

Recall that D^* involves $\frac{\partial P}{\partial y}$. For sufficiently small Δy, $\frac{\partial P}{\partial y} \approx \frac{\Delta P}{\Delta y}$.

$$\Rightarrow \frac{\Delta P}{\Delta y} = -PD^*$$

$$\Delta P = -PD^* \Delta y$$

Duration and Other Concepts

Recall: $DV01$

$DV01$ is the absolute value of the change in bond price when the yield increased by 1 basis point.

$$\begin{aligned} DV01 &= |-PD^*(0.01\%)| \\ &= \frac{1}{100^2} PD^* \end{aligned}$$

Exercise

Solve the bond pricing example earlier using Python. (We will go over the Python code for pricing bonds first thing next meeting.)