# Level I of the CFA® 2024 Exam

Study Notes - Fixed Income

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# Learning Module 1: Fixed Income Instrument Features

## LOS 1a: describe the features of a fixed-income security

Fixed-income securities encompass bonds and loans, serving as crucial avenues of debt financing for corporations and governments. These are formed under standardized agreements, where issuers obtain funds for operational or capital needs, and investors, in turn, lend their capital, expecting interest payments and the eventual return of the principal. These securities are part of a broader spectrum of corporate liabilities, with each debt type possessing unique features such as varying maturities, seniority levels, and currencies.

Importantly, fixed-income securities are distinctive from other liabilities as they involve cash-settled agreements with investors or banks. Governments typically use bond issuance as their primary financing strategy, though some also secure loans from international bodies like the IMF. A distinguishing characteristic of fixed-income securities from equities is their guaranteed periodic cash flows, offering investors regular income and capital return upon maturity.

## Key Characteristics of Fixed-Income Securities

### Issuer

A bond's issuer, whether it's a national government, a local body, or a private corporation, is responsible for making all interest and principal payments. Sovereign bonds usually carry the least risk due to governmental backing.

### Maturity

This signifies the end date when the issuer completes its payments to bondholders. Securities with a maturity period of one year or less are considered money market securities, while those extending beyond a year are capital market securities. Perpetual bonds, which do not have a definite maturity, are also a unique class of bonds.

### Principal



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This is the amount that the issuer agrees to repay to investors at the end of the bond's lifespan. Some securities may distribute principal repayment over time rather than in one lump sum at maturity.

## Coupon Rate and Frequency

Bond interest can be classified as fixed, variable, or part of a single payment at maturity. Fixed-coupon bonds involve regular payments at specific intervals (monthly, quarterly, semi-annual, or annual), with corporate bonds typically paying semiannually. Floating-rate notes (FRNs) have variable interest determined by combining a market reference rate (MRR) and a credit spread. Zero-coupon bonds, on the other hand, do not pay periodic interest; instead, they pay interest along with the principal at maturity and are usually issued at a discount to par value.

$$\text{Interest expense} = \frac{\text{Par Value of the bond} \times \text{Coupon rate}}{\text{Frequency of payments}}$$

## Seniority:

In terms of repayment during liquidation or bankruptcy, senior debt takes precedence over other forms of debt. Junior or subordinated debts are repaid only after senior debts are settled.

## Contingency Provisions

Bonds may include clauses for actions under certain circumstances. A contingency provision in bonds includes embedded options like call, put, and conversion to equity. These options cannot be traded separately from the bond but can be valued by comparing it with a similar bond without such provisions.

## Yield Measures

The bond's expected cash flows and its price can be used to determine yield measures like current yield and yield-to-maturity.

$$\text{Current yield} = \frac{\text{Annual coupon}}{\text{Bond price}} \times 100\%$$



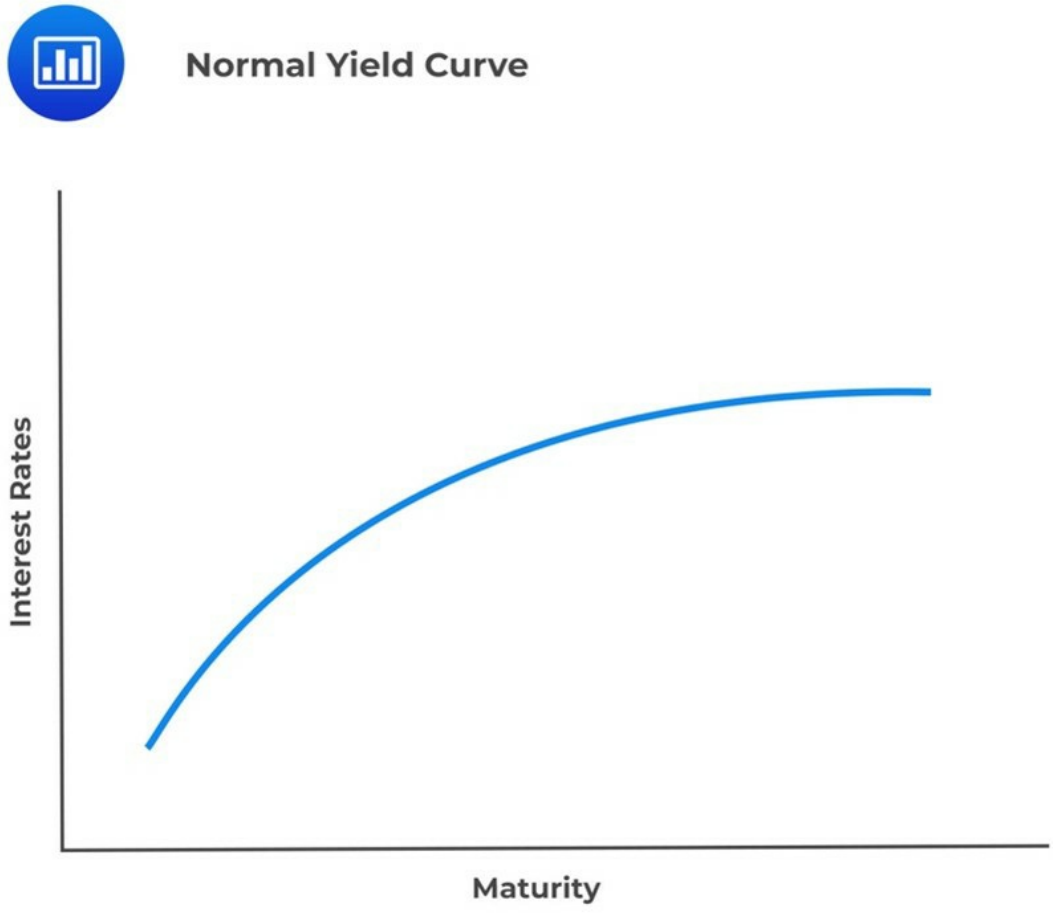
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Yield-to-maturity (YTM) is a more complex measure, calculated as the internal rate of return using the bond's price and its coupon payments until maturity. It is normally expressed as an annual rate. If all assumptions hold (no default, holding until maturity, reinvesting at YTM), the investor's rate of return will equal the bond's YTM at the time of purchase.

## Yield Curves

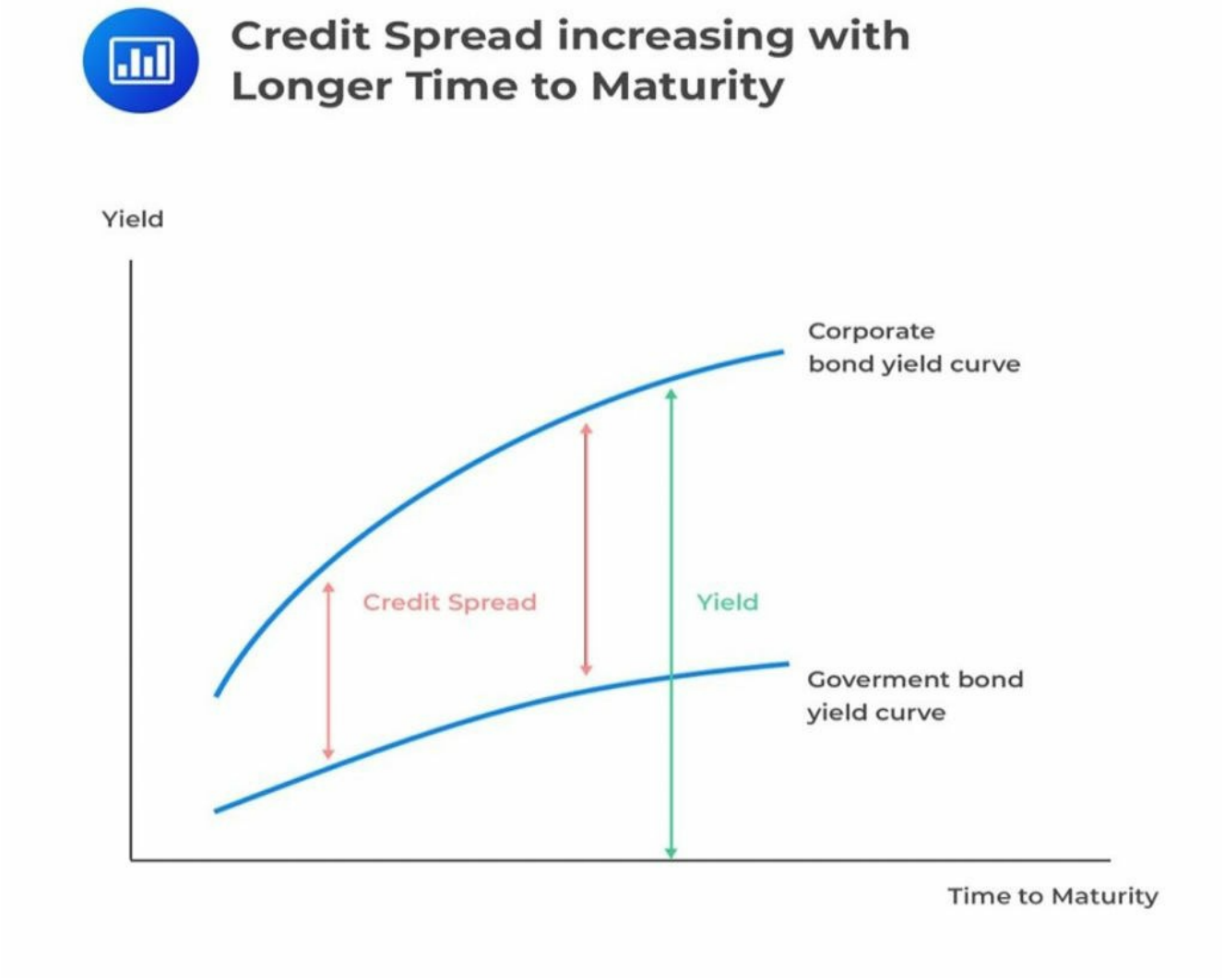
Plotting an issuer's bonds against their yield-to-maturity and time-to-maturity gives us a yield curve. It is a useful tool for comparing the expected returns on different bonds issued by the same entity. Comparing this with the yield curve of a risk-free bond, like a sovereign bond, gives a measure of the credit risk of the bond.

This is demonstrated in the charts that follow.






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## Question 1

The coupon payment on a 3% coupon bond with a par value of $200,000 and a quarterly payment frequency is *closest to*:

A. $666.67

B. $1500.00

C. $24000.00

**Solution**

The correct answer is **B.**

$$\text{Coupon payment} = \frac{\text{Par Value of the bond} \times \text{Coupon rate}}{\text{Frequency of payments}}$$

$$\text{Coupon payment} = \frac{\$200,000 \times 3\%}{4} = \$1,500$$

## Question 2

Calculate the annual interest payable for a USD 5 million FRN issued by a U.S. corporation, which pays quarterly interest equal to the three-month MRR plus 200 bps. If the three-month MRR is 1.75%, what is the corporation's FRN coupon interest payable for the period?

A. $46,875

B. $87,500

C. $187,500

**Solution**

The correct answer is **C.**

The FRN coupon consists of the MRR plus the issuer-specific spread.



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$$\text{FRN coupon} = \text{MRR} + \text{Spread}.$$
$$\text{FRN coupon} = 1.75\% + 2.00\%.$$
$$\text{FRN coupon} = 3.75\%.$$

$$\text{Annual interest} = \$5,000,000 \times 3.75\% = \$187,500$$

Which is $46,875 on a quarterly basis, but the question asks for the annual interest.



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**LOS 1b: describe the contents of a bond indenture and contrast affirmative and negative covenants**

# Bond Indentures

A bond indenture is a legal contract that outlines the obligations of the bond issuer and the rights of the bondholders. It is also known as a trust deed, and in regions like the United States and Canada, it's often referred to as the bond indenture. This contract lays the groundwork for all subsequent transactions between the bondholder and the issuer. Beyond defining the issuer's obligations and restrictions, the bond indenture also details the bond's features. It pinpoints the issuer's sources of repayment, commitments made to bondholders, and provisions that enhance the issuer's capacity to fulfill its debt obligations in full.

## Sources of Repayment

Repayment sources for bonds differ based on the issuer. National governments often leverage their sovereign right to tax economic activities. In contrast, local or regional governments might derive repayment funds from taxation or fees associated with infrastructure projects. Corporate bond investors predominantly depend on the firm's operating cash flows. Meanwhile, Asset-backed securities (ABS) are anchored in the cash flows generated from a collection of loans or receivables held by a designated special-purpose issuer.

# Bond Covenants

Covenants are provisions in the bond indenture. They are legally enforceable rules that borrowers and lenders agree upon when a bond is issued.

## Negative Covenants (Restrictions)

Negative covenants, often termed as restrictions, primarily aim to safeguard the interests of bondholders. They act as preventive measures, ensuring that the issuing firm refrains from actions that could escalate the risk of default. Examples of such covenants include restrictions on asset



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sales, negative pledges of collateral, limitations on further borrowings, and constraints on investments, disposal of assets, or the issuance of debt that is senior to existing obligations.

## Affirmative Covenants (Promises)

Affirmative covenants, also known as promises, are actions that the borrower commits to undertake. Unlike negative covenants, they do not typically curtail the operational decisions of the issuer. Examples include making punctual interest and principal payments to bondholders, ensuring and upkeeping assets, adhering to relevant laws and regulations, utilizing the proceeds from the bond issue appropriately, providing financial reports in a timely manner, allowing bondholders the option to redeem their bonds at a premium if the issuer undergoes acquisition, and clauses like the pari passu, which guarantees equal treatment of debt obligations. Another notable affirmative covenant is the cross-default clause, which signifies a default if the issuer defaults on any other debt obligation.

## Contrasting Affirmative and Negative Covenants

Affirmative Covenants are actions that the borrower promises to perform. They are typically administrative in nature and do not usually impose additional costs on an issuer nor materially constrain the issuer's discretion in operating its business. On the other hand, negative covenants are prohibitions on the borrower. They are designed to protect bondholders by preventing the issuer from taking certain actions that might increase the risk of default. However, they should not be so restrictive that they hinder the issuer from capitalizing on opportunities or adapting to changing business circumstances.



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## Question #1

What is the primary purpose of a bond indenture?

A. To specify the bond's features and identify the issuer's sources of repayment.
B. To provide a detailed history of the issuer's past financial performance.
C. To outline the voting rights of bondholders in the issuer's annual general meeting.

**Solution**

The correct answer is **A.**

A bond indenture is a legal contract that outlines the obligations of the bond issuer and the rights of the bondholders. It specifies the bond's features, the issuer's sources of repayment, and other commitments and provisions.

**B is incorrect:** The bond indenture does not provide a detailed history of the issuer's past financial performance; it focuses on the terms and conditions of the bond.

**C is incorrect:** Bondholders typically do not have voting rights in the issuer's annual general meeting; that privilege is reserved for equity shareholders.

## Question #2

Which of the following is *least likely* a source of bond repayment?

A. Operating cash flows of the firm for corporate bonds.
B. Fees from infrastructure projects for local governments.
C. Dividends from equity shares.

**The correct answer is C:** Dividends from equity shares are returns to equity shareholders and are not a source of bond repayment.

**A is incorrect:** Investors in corporate bonds rely on the operating cash flows of the firm as their primary source for interest and principal payments.



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**B is incorrect:** Local or regional governments may use fees from infrastructure projects as a source of bond repayment.

## Question #3

Which of the following is *most likely* the primary role of negative covenants in a bond indenture?

A. To specify actions that the borrower promises to perform.
B. To ensure that an issuer maintains the ability to make interest and principal payments.
C. To provide bondholders with voting rights in the issuer's decisions.

**Solution**

The correct answer is **B.**

Negative covenants are prohibitions on the borrower. They are designed to protect bondholders by preventing the issuer from taking certain actions that might increase the risk of default.

**A is incorrect:** This describes affirmative covenants, which specify actions the borrower promises to perform.

**C is incorrect:** Bondholders typically do not have voting rights in the issuer's decisions; that privilege is reserved for equity shareholders.



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## Learning Module 2: Fixed Income Cash Flows and Types

### LOS 2a: describe common cash flow structures of fixed-income instruments and contrast cash flow contingency provisions that benefit issuers and investors

Fixed income instruments have different cash flow structures that provide investors and issuers with various options to meet their specific financial goals, manage risks, and tailor their investments to suit their particular circumstances.

## Standard, Fixed-Rate Bond ("Bullet Bond")

A standard fixed-rate bond, often termed a "Bullet Bond", is a widely utilized debt instrument wherein the issuer receives the principal amount when the bond is issued and commits to repay that principal when the bond reaches its maturity. Throughout the bond's duration, the issuer makes regular, fixed coupon payments to the bondholder. When the final payment consists of a lumpsum combined with the interest of the last period, it's called a **balloon payment**.

One of the primary appeals of a bullet bond for both issuers, such as governments and corporations, and investors is its straightforward cash flow structure. For issuers, this bond provides a consistent and predictable financing mechanism. Investors, on the other hand, favor bullet bonds because of the guaranteed income stream via fixed coupon payments and the certainty of receiving the principal back at a set date, which can be useful for funding specific future cash flow needs.

### Example: Bullet Bond

Consider a $2,000 face value 7-year bond with an annual coupon rate of 4%. With a bullet structure, the bond's promised payments at the end of each year would be as follows.

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| PMT | $80 | $80 | $80 | $80 | $80 | $80 | $2,080 |
| Principal remaining | $2,000 | $2,000 | $2,000 | $2,000 | $2,000 | $2,000 | $0 |



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In the example above, every year for 6 years, the bondholder receives an interest payment of $80 (which is 4% of $2,000). At the end of the $7^{th}$ year, the bondholder receives the final interest payment along with the face value of the bond, totaling $2,080.

## Amortizing Principal

This structure is commonly seen in bonds, where the principal amount is gradually paid off over time through a series of periodic payments. The coupon payments, representing the interest, are made regularly throughout the life of the bond. At maturity, the final principal payment is made, completing the amortization process. This structure is frequently used in corporate and government bonds to manage repayment obligations.

### Fully Amortized Loan

In the case of loans, such as mortgage loans, the cash flows consist of both interest and principal portions. Borrowers make regular payments that include both the interest accrued and a portion that reduces the principal balance. Over the life of the loan, the principal is gradually paid down until the entire debt is repaid. This structure allows borrowers to build equity while repaying the loan.

The periodic payment is calculated as follows:

$$\text{PMT} = \frac{\text{i} \times \text{Principal}}{1 - (1 + \text{i})^{-\text{n}}}$$

Where:

PMT = Periodic payment amount

i = Interest rate

Principal = Principal amount of loan or bond

n = Number of payment periods

### Example: Fully Amortizing Bond



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Consider a $2,000 face value 7-year bond with an annual coupon rate of 4%. With a fully amortizing structure, the bond's promised payments at the end of each year would be as follows.

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| PMT | 333.22 | 333.22 | 333.22 | 333.22 | 333.22 | 333.22 | 333.22 |
| Interest | 80.00 | 69.87 | 59.34 | 48.38 | 36.99 | 25.14 | 12.82 |
| Principal payment | 253.22 | 263.35 | 273.88 | 284.84 | 296.23 | 308.08 | 320.40 |
| Principal Remaining | 1,746.78 | 1,483.43 | 1,209.55 | 924.71 | 628.48 | 320.40 | −0.01 |

Formula:

$$PMT = \frac{i \times Principal}{1-(1+i)^{-n}}$$

$$PMT = \frac{4\% \times 2,000}{1-(1+4\%)^{-7}} = 333.22$$

## Partially Amortizing Bond

A partially amortizing bond is a unique financial instrument where not all the principal amount borrowed is paid off over the bond's life. Unlike the standard bullet bond, where the full principal is repaid at maturity, in a partially amortizing bond, periodic payments are made that cover both interest and a portion of the principal. However, there remains a certain portion of the principal, referred to as the “balloon payment,” that is paid off only at the bond's maturity.

In our previous example, if the final payment includes $800 to repay the remaining principal outstanding, the principal outstanding at the end of every year is indicated in the following table:

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| PMT | 231.93 | 231.93 | 231.93 | 231.93 | 231.93 | 231.93 | 231.93 |
| Principal Remaining | 1,848.07 | 1,690.06 | 1,525.74 | 1,354.83 | 1,177.10 | 992.25 | 0.01 |

Subtracting the present value of the balloon payment from the $2,000 price of the bond gives us $1392.07 in principal repayment to amortize over 7 years to leave a remaining principal of $800 at maturity. Using this $1392.07 principal amount, we can compute the periodic payment amount as:

4% 1392.07



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$$\text{PMT} = \frac{4\% \times 1392.07}{1-(1+4\%)^{-7}} = 231.93$$

**Year 1:**

$\text{PMT} = 231.93$

Interest paid: $4\% \times 2000 = \$80$

Principal payment $= 231.93 - 80 = 151.93$

Principal remaining $= 2000 - 151.93 = 1848.07$

The last payment of $992.25 consists of the regular $231.93 payment combined with the remaining principal of $800.

## Sinking Funds

A sinking fund is an arrangement predominantly used by bond issuers, including governments and select corporate entities. In this setup, issuers systematically allocate funds into a special escrow or sinking fund account. This proactive strategy is deployed to ensure they can meet their repayment obligations, thereby reducing the inherent credit risk of default. Through the sinking fund, issuers retire a predetermined amount of the bond's principal over its lifetime. This retirement can either be executed by redeeming bonds chosen at random or by exercising the option to repurchase bonds prior to maturity at a specified price, as outlined during the bond issuance. While this strategy undeniably minimizes credit risk by ensuring funds are set aside for repayment, it introduces a layer of reinvestment risk for bondholders. This stems from the potential early retirement of bonds, compelling bondholders to possibly reinvest in securities with lower returns.

## Waterfall Structures

Waterfall structures are integral to the functioning of asset-backed securities (ABS) and mortgage-backed securities (MBS). Within a waterfall structure, the distribution of cash flows is organized in a hierarchical manner among various tranches or investor classes. While interest or coupon payments are generally disbursed to all tranches without any specific order, the repayment of the principal



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observes a defined pecking order. The tranche designated as the most senior receives its principal payment first. Upon its complete repayment, the next tranche in line begins receiving its principal, and this sequence persists until the most junior tranche is addressed.

## Variable Interest Debt

Variable interest debt instruments, such as certain bonds and loans, adjust their interest payments based on a market reference rate (MRR) coupled with a credit spread. This dynamic structure makes them favorable for various stakeholders. For instance, financial intermediaries, especially banks, show a predilection for these assets because they conveniently align with their variable-rate liabilities. Moreover, floating-rate notes (FRN), another form of this debt, are especially attractive to investors keen on capitalizing on rising interest rates. A simple mathematical representation to determine the FRN coupon is: FRN coupon = MRR + Credit spread.

### Interest Rate and Credit Risks

While these variable-rate instruments have been designed to reduce interest rate risk—given that their coupon payments are modulated with fluctuating interest rates—they are not free of risks. Credit risk remains a concern. If there's a perceived decline in an issuer's credit quality, irrespective of the MRR's status, the instrument's price may plummet.

### Mechanisms of Rate Adjustments

Beyond the regular adjustments based on MRR, these instruments come with various innovative features:

- Step-up Bonds: These bonds have an in-built mechanism where the coupon rates ascend at predetermined intervals.
- Event-based Adjustments: These are contingent on specific events, like a drop in an issuer's creditworthiness. Sometimes, these adjustments might even be tethered to certain financial covenants or credit ratings.



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## Leveraged Loans

Leveraged loans, typically extended to issuers perceived as lower credit quality, have their own set of dynamics. The coupon rate, for example, may surge if the issuer's credit quality takes a hit. This surge ensures that investors are compensated with a higher yield. A case in point is the Antelas AG scenario, where a loan's credit spread might be recalibrated based on specific financial ratios.

## Payment-in-Kind (PIK) Bond

Certain issuers, wary of future cash flow challenges, might opt for the PIK feature in their loans or bonds. This unique feature allows these issuers to pay interest by augmenting the bond or loan principal instead of traditional cash payments. Notably, this arrangement is more prevalent among firms that are heavily reliant on debt.

## Sustainability and ESG-linked Bonds

The financial world is becoming increasingly conscious of environmental, social, and governance (ESG) factors. Responding to this trend, bonds with provisions related to ESG have emerged. A prominent example is the sustainability-linked bond issued by the Public Power Corporation. Here, bonds might undergo step-up margins if they don't meet certain ESG benchmarks.

## Index-Linked Bonds

Index-linked bonds offer another layer of sophistication. Their payments are tethered to specific indices. The most prevalent among these are the inflation-linked bonds, colloquially known as ‘linkers’. Their primary function is to act as a shield against inflation, offering stakeholders inflation-adjusted cash flows. A widely recognized example is the U.S.'s Treasury Inflation-Protected Securities (TIPS), which modulate their cash flows based on inflation metrics like the Consumer Price Index.

## Classifications of Index-linked Bonds

- **Capital-indexed Bonds**: These types, exemplified by TIPS, adjust their principal in line



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with inflation metrics, safeguarding the real value of the debt principal against inflation.

- **Interest-indexed Bonds**: These bonds keep the maturity amount constant, adjusting only the coupon against an index. They are essentially variations of FRNs where inflation acts as the MRR. Significantly, they find more favor with private entities than with governments.

## Zero-Coupon Bonds

These fixed-income instruments do not make regular interest payments like traditional bonds. Instead, they are sold at a discount to their face value and do not provide periodic income. Investors earn their return by purchasing the bonds at a discount and receiving the full face value at maturity. Zero-coupon bonds are often used in situations where investors are seeking a predictable lump sum payout in the future.

## Deferred Coupon Bonds

This structure includes bonds that have a deferred coupon payment, meaning they do not pay interest for a specified initial period. After the deferral period, the bond starts making regular coupon payments that are typically higher than the market rate to compensate for the earlier period without interest. This structure is commonly utilized in projects or financial instruments where cash flows are expected to be limited in the early stages, such as infrastructure projects or issuances from entities with lower credit quality.

## Fixed-Income Contingency Provisions

Bonds often come with certain conditional provisions known as contingency provisions. These provisions dictate actions that may be taken contingent upon specific events. They embed within the bond contract the rights but not obligations to undertake certain actions. Depending on their nature, these provisions can either add value to the issuer or the bondholder. Among the numerous types of



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bonds with such embedded options are callable, putable, and convertible bonds.

## Callable Bonds

These bonds predominantly favor the issuer, as they provide the issuer the right to redeem or “call” the bond before its maturity. The underlying motivation is protection against falling interest rates. By doing so, the issuer can replace an old bond with a higher interest rate with a new bond with a potentially lower interest rate, thus reducing its borrowing cost. This presents reinvestment risks for the investor since if interest rates fall, the issuer is more likely to call the bond, meaning the investor may then have to reinvest in a lower-yielding environment. To compensate for this risk, callable bonds generally offer a higher yield.

A call premium is the amount over the par value that the issuer pays if they decide to redeem the bond before maturity. The call protection period also referred to as the lockout period or cushion, represents the initial period during which the issuer cannot call the bond. This protection incentivizes investors by offering them some security against early redemption.

There's also a unique callable bond variant called a make-whole call. Instead of a fixed call premium, the issuer makes a payment determined by the present value of future coupons, making early redemption significantly more expensive.

Furthermore, the manner in which a bond can be called can vary:

i. American-style: These continuously callable bonds can be called at any time post the call protection period.
ii. European-style: The bond can only be called once, specifically on the designated call date.
iii. Bermuda-style: This is a mix of the two, allowing for the bond to be called on certain specified dates following the end of the call protection period.

## Putable Bonds

While callable bonds cater to issuers, putable bonds cater to bondholders. These bonds grant



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bondholders the right to “put” or sell the bond back to the issuer at predetermined prices on specified dates. This is particularly advantageous if interest rates spike, as bondholders can then liquidate the bond and reinvest the proceeds at higher yields. Consequently, putable bonds often fetch a higher price compared to regular bonds. Like their callable counterparts, putable bonds also have the European and Bermuda styles based on the frequency and timing of the put option.

## Convertible Bonds

Blurring the lines between debt and equity, convertible bonds offer bondholders a choice: they can either hold onto the bond or convert it into a predetermined number of common shares of the issuing company. This dual feature—bond downside protection and potential equity upside—makes convertibles relatively attractive, thus often garnering a higher price.

An alternative to convertibility is the inclusion of warrants. Unlike the embedded nature of the convertible option, a warrant is an additional, separable option that grants the holder the right to purchase shares at a given price within a set timeframe. Often considered a “sweetener”, warrants can make bonds more appealing, especially for younger firms. They offer the potential for additional returns if the company's shares are appreciated.

Lastly, there's a unique bond variant known as Contingent Convertible Bonds or CoCos. Primarily issued by some European banks, these bonds automatically convert from debt to equity upon the occurrence of specific events, as the issuer's equity drops below a particular level.



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## Question #1

Calculate the periodic payment and the interest and principal components of the first payment for a fully amortizing bond based on the following:

A. Loan amount: $15 million
B. Annual interest rate: 3.5%
C. Loan term: 8 semiannual periods (4 years)

**Solution:**

Formula:

$$PMT = \frac{i \times Principal}{1-(1+i)^{-n}}$$

Where

- $i = \frac{(3.5\%)}{2} = 1.75\%$
- Principal =$15 million
- n=8

Solve for the periodic payment as follows:

$$PMT = \frac{0.0175 \times 15}{1-(1.0175)^{-8}} = \$2.026 \text{ Million}$$

The initial $2.026 Million periodic payment comprises the following:

- Initial interest payment: $\$15 \times 1.75\% = \$0.2625$ million
- Initial principal repayment: = $2.026 Million − $0.2625 million = $1.7635 million



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## Question #2

Which bond structure involves periodic payments that cover both interest and a portion of the principal, but not all of the principal amount is paid off over the bond's life?

A. Bullet Bond
B. Fully Amortizing Bond
C. Partially Amortizing Bond

**Solution**

The correct Answer is **C.**

A partially amortizing bond includes periodic payments that cover both interest and some of the principal, leaving a portion of the principal, known as a "balloon payment," to be paid off at maturity.

**A is incorrect:** A bullet bond involves only interest payments throughout its life with the full principal returned at maturity.

**B is incorrect:** A fully amortizing bond involves periodic payments that cover both interest and principal such that the entire principal is paid off by maturity.

## Question #3

For which bond structure are funds allocated into a special account to ensure repayment obligations and reduce credit risk?

A. Amortizing Principal
B. Sinking funds
C. Waterfall Structures

**Solution**

The correct answer is **B.**



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Sinking funds are provisions used by bond issuers to systematically allocate money into a special account. This strategy is used to ensure that they can meet their repayment obligations, reducing the credit risk of default.

**A is incorrect:** Amortizing principal's structure involves the gradual repayment of principal over the bond's life.

**C is incorrect:** Waterfall Structures relate to the hierarchical distribution of cash flows among various tranches or investor classes in asset-backed securities.



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## LOS 2b: describe how legal, regulatory, and tax considerations affect the issuance and trading of fixed-income securities

Fixed-income securities depend on laws and regulations of the place of issuance, where bonds are traded, and the holders of bonds.

# Classification of Bonds by Jurisdiction

1. **Domestic Bonds**

   These are bonds issued by entities incorporated within a country and traded within that country. For example, when a US company like Apple issues bonds in the US, these are domestic bonds.

2. **Foreign Bonds**

   Foreign bonds are issued by entities that are not native to the country in which they're traded. The classic examples are the Yankee bonds (issued by foreign entities in the US) and Samurai bonds (issued by non-Japanese firms in Japan). For instance, if a French company like Renault issues bonds in the United States, these are foreign bonds.

3. **Eurobonds**

   These bonds are issued outside the jurisdiction of any single country and can be denominated in any currency. They were primarily introduced in the 1960s to sidestep certain regulations and are often named based on the currency they are denominated in. For instance, a Eurobond issued in US dollars is called a Eurodollar bond.

4. **Global Bonds**

   Global bonds are a type of bond that are issued simultaneously in multiple markets, typically in the Eurobond market and at least one domestic bond market. They allow issuers to access a broader investor base and increase liquidity.

## Emerging and Frontier Markets



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Bonds from emerging and frontier markets can differ in characteristics and risk factors. In frontier markets, which are typically smaller and less mature than emerging markets, bond issuances are dominated by domestic sovereign bonds or bonds from local banks. Corporate financing in these markets is generally through bank loans. In contrast, larger emerging markets might have a mix of state-owned enterprises, private corporations, and sovereign entities issuing bonds.

### The Role of Currency in Bond Markets

The currency in which a bond is denominated can significantly influence its price. This is because the currency will dictate the interest rate environment to which the bond is tied. For instance, a bond denominated in a high-inflation currency might have a much higher interest rate than a similar bond in a stable, low-inflation currency.

## Tax Considerations for Bonds

### Interest Taxation

Bond interest might be taxed at ordinary income rates. This tax treatment varies by country and can depend on the type of bond. For instance, municipal bonds in the US can provide tax-free interest income.

### Capital Gains

If bonds are sold before maturity at a price different than the purchase price, they may generate capital gains or losses. These, too, can have specific tax treatments depending on the holding period.

### Original Issue Discount (OID)

Bonds like zero-coupons are issued at a discount to their par value. This discount can be treated as interest, and the taxation of this interest can vary by country.



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## Question

PT Indonesia Infrastructure Finance (IIF) decided to issue a bond denominated in US dollars with terms that it would be available to a broader set of international investors and would be traded in the Eurobond market. This bond can best be described as:

A. Eurobond
B. Foreign bond
C. Global bond

**Solution**

**The correct answer is A:** Eurobonds are bonds issued outside the jurisdiction of any single country and can be denominated in any currency, including the issuer's domestic currency. They are underwritten by a group of financial intermediaries from different jurisdictions and are typically sold to investors in Europe, the Middle East, and Asia. In the given scenario, IIF's bond fits this description, given its US dollar denomination and its listing for broader international trading.

**B is incorrect:** A foreign bond is a bond issued in a domestic market by a foreign entity, denominated in the domestic market's currency. Since the IIF bond is not necessarily issued in a foreign domestic market and is denominated in US dollars, it does not fit the description of a foreign bond.

**C is incorrect:** A global bond is a bond issued simultaneously in the Eurobond market and in at least one domestic bond market. While the IIF bond is issued in the Eurobond market, there's no indication in the provided notes that it's simultaneously issued in any domestic bond market.

This question encapsulates the understanding of different bond types and their respective markets, and it requires the respondent to differentiate between bonds based on issuance location, trading location, and currency denomination.



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# Learning Module 3: Fixed Income Issuance and Trading

## LOS 3a: describe fixed-income market segments and their issuer and investor Participants

The fixed-income market is a multifaceted arena where various instruments are traded based on distinct classifications. These instruments can be broadly categorized based on three primary dimensions: time to maturity, issuer type, and credit quality. Additionally, classifications can be extended to encompass issuers' geography, currency, and ESG (Environmental, Social, and Governance) characteristics.

### Time to Maturity

Instruments in the fixed-income market can be segmented by their maturity duration:

i. **Short-Term (< 1 year)**: Instruments in this category, such as Treasury bills, Repo, and commercial paper, cater to near-term obligations. Investors seeking liquid cash alternatives often turn to these money market securities.
ii. **Intermediate-Term (1-10 years)**: Instruments like Treasury notes, Asset-Backed securities (ABS), and unsecured corporate bonds fall under this segment. Investors looking to match the cash flows of known future obligations might consider these instruments.
iii. **Long-Term (> 10 years)**: This segment comprises Treasury bonds and mortgage-backed securities. Pension funds and insurance companies with long investment time horizons favor these fixed-income instruments due to their fixed periodic coupon cash flows and maturity profile that matches their long-term liabilities.

Across these maturity spectrums, investors might also take on varying degrees of credit risk to augment returns.

### Issuer Type

The market sees a diverse range of issuers, each with its unique financial instruments:

i. Sovereign Governments: These issuers, especially from developed markets, are often



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perceived as having the lowest credit risk. Their bonds, such as Treasury bills, notes, and bonds, are widely held by foreign investors and central banks.

ii. Corporations: Companies, exemplified by entities like Apple Inc., issue a variety of fixed-income instruments, ranging from short-term commercial paper to long-term bonds, to finance their operations.

## Credit Quality

Credit quality is assessed through credit ratings, which gauge an issuer's ability to meet debt obligations based on default likelihood and potential loss. Key agencies like Standard & Poor's (S&P) and Moody's provide these ratings.

## S&P Credit Ratings

### Investment Grade

i. AAA: Highest credit quality.
ii. AA: Very strong capacity.
iii. A: Strong but with some vulnerability.
iv. BBB: Adequate capacity with susceptibility to economic shifts.

### Speculative Grade or High Yield:

**BB to D:** Ranges from less vulnerable in the short term to payment default or bankruptcy.

Developed market sovereign issuers, often with AAA ratings, are viewed as highly creditworthy. Their bonds are favored by foreign investors and central banks. Sovereign bonds also play a key role in domestic monetary policy.

Issuers rated BBB- (or Baa3 by Moody's) and above are termed investment grade. Those rated BB+ (or Ba1 by Moody's) and below are high-yield or junk. High-yield issuers, distinct from investment-grade ones, often represent new entities. Investors tend to demand collateral from them due to their inconsistent operating cash flows. Investment-grade issuers that have seen a decline in their credit quality after their initial issuance are referred to as fallen angels.



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## Question #1

Which of the following fixed-income instruments is *most likely* to be favored by pension funds and insurance companies due to its long-term maturity profile and fixed periodic coupon cash flows?

A. Treasury bills
B. Asset-Backed securities (ABS)
C. Treasury bonds

**Solution**

**The correct answer is C:**

Treasury bonds fall under the long-term (>10 years) segment of the fixed-income market. Pension funds and insurance companies with long investment time horizons favor these fixed-income instruments due to their fixed periodic coupon cash flows and maturity profile that matches their long-term liabilities.

**A is incorrect:** Treasury bills are short-term instruments with a maturity of less than one year.

**B is incorrect:** Asset Backed securities (ABS) typically have an intermediate-term maturity of 1-10 years.

## Question #2

Which of the following credit ratings from Standard & Poor's (S&P) is *most likely* considered to be in the speculative grade or high yield category?

A. A
B. BBB
C. BB



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**Solution**

**The correct answer is C:**

BB is a rating that falls under the speculative grade or high yield category according to S&P's credit ratings.

**A is incorrect:** "A" is considered to be investment grade and indicates a strong capacity with some vulnerability.

**B is incorrect:** "BBB" is the lowest investment grade rating, indicating adequate capacity with susceptibility to economic shifts.

## Question #3

Which term refers to investment-grade issuers that experience a decline in their credit quality after their initial issuance?

A. Fallen angels
B. Junk bonds
C. High-yield issuers

**Solution**

**The correct answer is A:**

Fallen angels refer to investment-grade issuers that have seen a decline in their credit quality after their initial issuance.

**B is incorrect:** Junk bonds refer to bonds that are rated below investment grade, but it doesn't necessarily mean they were initially rated as investment grade.

**C is incorrect:** High-yield issuers are those that issue bonds rated as high yield or junk, but this term doesn't specify the issuer's initial rating.



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## LOS 3b: describe types of fixed-income indexes

# Purpose of fixed income Indexes

Fixed-income indexes are pivotal in tracking the broad risk and return of bond markets. They serve to evaluate market performance, benchmark the performance of investments and investment managers, and lay the foundation for indexed investment strategies.

## Equity vs. Fixed-Income Indexes

While they share similarities in function with equity indexes in stock markets, fixed-income indexes have distinct characteristics that set them apart.

## Distinguishing Features of Fixed-Income Indexes

a. **Multiplicity of Securities**

   A unique aspect of the fixed-income market is that a single issuer can have multiple securities. This leads to fixed-income indexes having a larger number of constituents compared to equity indexes. In fact, certain indexes can have over 10,000 constituents.

b. **High Turnover**

   The inherent nature of bonds, with their finite maturity and the frequent introduction of new issuances, results in a higher turnover for fixed-income indexes. A common practice is the monthly rebalancing of these indexes to accommodate new issues and phase out those nearing maturity.

c. **Weighting Mechanism**

   In a manner similar to equity indexes, which are weighted by issuers' market capitalization, bond indexes typically weigh constituents based on the market value of outstanding debt. This means that broad bond indexes can undergo changes over time, reflecting shifts in the bond market landscape, such as the balance between public and private issuer debt, changes in maturity lengths, and shifts in credit quality. A notable observation is the significant



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weightage of government debt in many broad bond indexes attributed to the substantial issuance volume by government entities.

## Classifying Fixed-Income Indexes

i. **Aggregate Indexes**: Characterized by a vast array of constituents.
ii. **Narrower indexes**: These are more refined, drawing criteria such as sector, credit quality, maturity duration, geographical focus, and ESG considerations.

It is imperative that the chosen index resonates with the investment strategy of the fund or manager in question.

### Illustrative Examples

a. ***Bloomberg Barclays Global Aggregate Index***

The inclusion criteria is summarized below:

i. Issuers: Fixed-rate bonds from various entities, including sovereign, government, corporate, and securitized issuers from both developed (DM) and emerging (EM) markets.
ii. Currencies: Encompasses 28 currencies from the Americas, EMEA, and Asia Pacific.
iii. Credit quality: Must have an investment-grade rating or its equivalent.
iv. Maturity: Bonds should have at least a year to final maturity or an average weighted maturity.
v. Rebalancing: Done monthly, adjusting for new issues and removing bonds that no longer meet criteria.

b. ***J.P. Morgan Emerging Markets Bond Index Plus (EMBI+)***

The inclusion criteria is summarized below:

i. Issuers: Focuses on emerging market sovereign entities issuing US dollar debt.
ii. Currencies: Only includes US dollar-denominated bonds.
iii. Credit quality: Bonds rated Baa1/BBB+/BBB+ or below by major rating agencies.



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iv. Maturity: Considers bonds with at least 2.5 years to maturity, excluding those falling below a 12-month maturity in the upcoming month.
v. Rebalancing: Done on the last US business day of each month.
vi. Characteristics: This index zeroes in on US dollar–denominated debt from sovereign governments with a specific credit quality, targeting higher returns than developed market sovereign bonds.

c. ***Bloomberg Barclays MSCI Euro Corporate Sustainable SRI Index***

The inclusion criteria is summarized below:

i. Issuers: Corporate entities like industrial, utility, and financial institutions.
ii. Currencies: Only includes euro-denominated bonds.
iii. Credit quality: Bonds rated Baa3/BBB-/BBB- or above by major rating agencies.
iv. Maturity: Bonds with at least a year to final maturity are considered.
v. Rebalancing: Done on the last US business day of each month.
vi. ESG rules: Bonds must have an MSCI ESG rating of BBB or higher and exclude issuers involved in certain business activities or controversies.

## Incorporating ESG in Fixed-Income Indexes

ESG-focused bond indexes adopt a rigorous screening process to exclude issuers that don't meet certain ESG benchmarks. This can involve filtering out issuers engaged in specific business activities or those that don't achieve the required ESG ratings.



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## Question 1

Which feature best distinguishes fixed-income indexes from equity indexes?

A. Fixed-income indexes are weighted by issuers' market capitalization.
B. A single issuer in the fixed-income market can have multiple securities.
C. Fixed-income indexes have fewer constituents than equity indexes.

**Solution:**

**The correct answer is B:** One unique aspect of the fixed-income market is that a single issuer can have multiple securities, leading to fixed-income indexes having potentially many constituents.

**A is incorrect:** Both equity and fixed-income indexes can be weighted by market capitalization or the market value of outstanding securities.

**C is incorrect:** Fixed-income indexes can have a larger number of constituents compared to equity indexes, with some having over 10,000 constituents

## Question 2

Which index would *most likely* exclude issuers involved in the alcohol and tobacco industries due to ESG considerations?

A. Bloomberg Barclays Global Aggregate Index
B. J.P. Morgan Emerging Markets Bond Index Plus (EMBI+)
C. Bloomberg Barclays MSCI Euro Corporate Sustainable SRI Index

**Solution:**

**The correct answer is C:** The Bloomberg Barclays MSCI Euro Corporate Sustainable SRI Index has ESG rules that exclude issuers involved in certain business activities, including alcohol and tobacco.



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**A is incorrect:** The Bloomberg Barclays Global Aggregate Index does not specifically mention excluding issuers based on ESG considerations related to alcohol and tobacco.

**B is incorrect:** The J.P. Morgan EMBI+ does not specifically mention ESG considerations in its criteria.



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## LOS 3c: compare primary and secondary fixed-income markets to equity Markets

# Primary Fixed-Income Markets

Primary bond markets are where issuers sell new bonds to investors to raise capital. This contrasts with secondary bond markets, where existing bonds are traded among investors. **Debut issuers** are those who approach the bond market for the first time. They often replace private debt, like bank loans, with bonds. Examples include:

i. New corporate entities formed post-merger or acquisition.
ii. Mature companies with predictable cash flows.
iii. Sovereign governments raising external foreign currency debt for the first time.

### Issuance Process

i. **Underwritten Bond Offering:** Financial intermediaries guarantee the sale of the bond issue at an agreed price with the issuer. This process is usually quick for frequent issuers.
ii. **Best-Efforts Offering:** The intermediary tries to sell the bond issue on a commission basis at the negotiated price only if possible.
iii. **Private Placement:** Bonds are sold to a select group of investors, often when the bond size is small or the issuer is less known.
iv. **Sovereign Debt Issuance:** Typically takes the form of a public auction led by the national treasury or finance ministry.

# Secondary Fixed-Income Markets

Secondary Fixed-Income Markets are predominantly over-the-counter (OTC) in nature, although there are some electronic marketplace platforms available. The main participants in these markets are institutional investors, financial intermediaries, and central banks.

Liquidity in these markets can vary significantly across different fixed-income market segments. The



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bid–offer spread serves as a crucial measure of liquidity. The most liquid securities in this space are typically the on-the-run developed market sovereign bonds. Additionally, corporate bonds that have been recently issued by frequent issuers tend to have higher liquidity. In contrast, bonds from less frequent issuers or those that are seasoned from frequent issuers are traded less often.

There is also a category known as Distressed Debt, which comprises bonds from issuers that are nearing or have declared bankruptcy. These bonds are traded at prices significantly below their par value because bondholders are expected to not receive all the promised payments. Such distressed debts are particularly attractive to opportunistic investors who are in pursuit of returns similar to equities. On the other hand, a significant number of bond issues are illiquid, meaning they don't see regular trading. For these illiquid bonds, price quotes are often based on estimates, which are derived from bonds that are more liquid in nature.

## Comparison to Equity Markets

i. **Equity IPOs vs. Bond Debut Issuers:** Just as companies can have an initial public offering (IPO) in the equity market, issuers can approach the bond market for the first time.
ii. **Trading platforms:** While equity markets often operate on centralized exchanges, fixed-income markets are mostly OTC.
iii. **Liquidity:** Equity markets generally have higher liquidity than many segments of the fixed-income market.
iv. **Distressed securities:** When a company's debt becomes distressed, its equity securities might already be delisted from exchanges.



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## Question #1

Which of the following best describes the primary bond market?

A. A market where existing bonds are traded among investors.
B. A market where issuers sell new bonds to investors to raise capital.
C. A market predominantly for trading distressed debts.

**Solution**

The correct answer is **B.**

In the primary bond market, issuers sell new bonds to investors to raise capital. This is distinct from the secondary bond market where existing bonds are traded among investors.

**A is incorrect:** This describes the secondary bond market.

**C is incorrect:** Distressed debts are a specific category of bonds and not the primary focus of the primary bond market.

## Question #2

Which type of bond offering involves a financial intermediary trying to sell the bond issue on a commission basis at the negotiated price only if it can do so?

A. Underwritten Bond Offering
B. Best-Efforts Offering
C. Private Placement

**Solution**

The correct answer is **B.**



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In a Best-Efforts Offering, the financial intermediary tries to sell the bond issue on a commission basis at the negotiated price only if possible.

**A is incorrect:** In an Underwritten Bond Offering, financial intermediaries guarantee the sale of the bond issue at an agreed price with the issuer.

**C is incorrect:** Private Placement involves selling bonds to a select group of investors, often when the bond size is small or the issuer is less known.



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# Learning Module 4: Fixed Income Market for Corporate Issuers

## LOS 4a: compare short-term funding alternatives available to corporations and financial institutions

Short-term funding is key for corporations to meet immediate cash needs, maintain liquidity, and capitalize on supplier discounts.

## Short-Term Funding Alternatives for Non-Financial Institutions

## External Financing

Non-financial entities can acquire immediate liquidity through various banking avenues:

### Uncommitted Lines of Credit

These are provisional credit arrangements where there's no obligation for the bank to lend the specified amount. They are useful for immediate liquidity needs. Banks typically grant these lines to clients with stable cash deposits, which allows them to monitor the company's financial activities closely. Uncommitted lines of credit are cost-efficient since there are no upfront fees, and companies are charged interest only on the utilized amount. However, given their 'uncommitted' nature, they are not always reliable, especially during financial downturns.

### Regular (Committed) Lines of credit

Contrary to the uncommitted lines, these involve a formal contractual obligation by the bank to provide the funds up to the agreed limit. They are often utilized as backup credit sources, and they can be categorized as short-term liabilities when drawn. They are more reliable than uncommitted lines, but there might be upfront costs, such as a commitment fee. Renewal at maturity can become a challenge, especially for companies whose financial positions are deteriorating.



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## Revolvers (Revolving Credit Agreements)

Revolvers are long-term credit arrangements that can span several years. They may come with specific covenants or conditions the borrower needs to adhere to. They can also include medium-term loan options. Being a multi-year commitment, they provide a dependable source of liquidity. However, due to their extended nature, lenders often seek protections to safeguard their interests.

1. **Secured Loans and Factoring**Secured Loans are those that demand collateral like company-owned assets or high-quality receivables, inventory, and securities. The lender secures a right on the collateral until the loan is cleared, reflecting on the borrower's credit report. Companies with inadequate credit strength typically opt for these loans.Companies can utilize their accounts receivable in two main ways:
    i. Assignment of accounts receivable: Here, receivables act as collateral for loans, but the responsibility of collection remains with the company.
    ii. Factoring: This involves selling receivables to a factor, usually at a discount. Here, the factor handles the credit granting and collection.
2. **External, Security-Based Financing**

    **Commercial Paper (CP)**

    Commercial Paper (CP) is predominantly issued by big, high-credit corporations, CPs are short-term, unsecured notes which generally mature in under three months. They are used for working capital, bridging finance, or handling seasonal cash demands. A common practice is “rolling over” or paying off maturing CP with new issuances. This introduces “rollover risk” - the potential inability to issue new CP. To counteract this, investors typically seek a liquidity enhancement, like a backup credit line from banks. This acts as a protective measure, ensuring issuers can fully repay their obligations if new issuances aren't viable. Given their brief maturity, CP markets are agile in adjusting to credit hiccups, making defaults infrequent. Beyond non-financial corporations, other CP issuers include governments, financial institutions, and international bodies.

    **Eurocommercial Papers (ECPs)**

    Eurocommercial Papers (ECPs) are CPs issued internationally. While they share many



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similarities with the U.S. Commercial Paper (USCP), they tend to involve smaller transaction sizes and are generally less liquid.

## Short-Term Funding Alternatives for Financial Institutions

Financial institutions, such as banks, serve as intermediaries between depositors and borrowers. Their assets mainly comprise loans given or securities purchased, while liabilities include deposits, securities sold, and short-term borrowings. Here's a closer look at their short-term funding sources:

### Deposits Demand Deposits

Primarily from households and commercial entities, these deposits don't have a stated maturity and often pay minimal interest. While they can be withdrawn anytime, banks count on them due to added stability. Operational deposits, generated through clearing, custody, and cash management activities, also offer a stable source of funding.

### Saving Deposits

These are non-transactional and may have defined terms. Certificates of deposit (CDs) are an example where banks offer pre-set maturity and interest rates. CDs can be non-negotiable or negotiable, allowing for early withdrawal with penalties or market selling. CDs are also found in the Eurobond market.

### Interbank Market Unsecured Loans

This market facilitates short-term lending and borrowing among financial institutions. Loans usually span from overnight to one year. The rate of interest on these loans is affected by credit risk, and banks often set counterparty limits to manage this risk.

### Central Bank Funds Market

Banks are mandated to maintain reserves with the central bank. Banks with a surplus can lend to



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those short on reserves through this market. The rate of borrowing and lending in this space is known as the central bank funds rate. Banks struggling in the interbank market can borrow directly from the central bank, albeit at higher rates and with more scrutiny.

## Commercial Paper (CP)General CP

Predominantly, large financial institutions issue CPs to cater to their short-term borrowing needs. About 60% of the yearly issuance is from financial institutions and the rest from non-financial corporate entities. These institutions need to manage the rollover risk associated with CP.

## Asset-Backed Commercial Paper (ABCP)

This is a secured variant of CP. Loans or receivables are typically sold to a special-purpose entity (SPE) that issues debt. The bank trades short-term loans for cash with the SPE, which in turn issues ABCP to investors with a backup credit line from the bank. This off-balance-sheet financing benefits the bank and investors as it offers liquidity and access to loan portfolios. However, during the Global Financial Crisis, challenges in rolling ABCPs led to multiple SPE failures. Post-crisis, the ABCP market primarily funds short-term, high-quality loans and receivables.



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## Question #1

Which of the following best describes a credit arrangement where the bank has no obligation to lend the specified amount and is typically granted to clients with stable cash deposits?

A. Revolvers (Revolving Credit Agreements)
B. Uncommitted Lines of Credit
C. Regular (Committed) Lines of Credit

**Solution**

**The correct answer is B:**

Uncommitted Lines of Credit are provisional credit arrangements where the bank has no obligation to lend the specified amount. They are granted to clients with stable cash deposits, allowing the bank to monitor the company's financial activities closely.

**A is incorrect:** Revolvers (Revolving Credit Agreements) are long-term credit arrangements that span several years and often come with specific covenants.

**C is incorrect:** Regular (Committed) Lines of Credit involve a formal contractual obligation by the bank to provide funds up to an agreed limit.

## Question #2

Which of the following is a type of commercial paper issued internationally *most likely* involves smaller transaction sizes, and is less liquid compared to its domestic counterpart?

A. Eurocommercial Papers (ECPs)
B. U.S. Commercial Paper (USCP)
C. Asset-Backed Commercial Paper (ABCP)



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**Solution**

The correct answer is **A.**

Eurocommercial Papers (ECPs) are commercial papers issued internationally and tend to involve smaller transaction sizes and are generally less liquid compared to U.S. Commercial Papers.

**B is incorrect:** U.S. Commercial Paper (USCP) is domestically issued and does not fit the international criterion.

**C is incorrect:** Asset-Backed Commercial Paper (ABCP) is a secured variant of CP, and its definition does not match the given description.

## Question #3

In the context of short-term funding for financial institutions, which deposit type *least likely* have a stated maturity and is relied upon by banks due to its stability?

A. Saving Deposits
B. Demand Deposits
C. Certificates of Deposit (CDs)

**Solution**

The correct answer is **B.**

Demand Deposits primarily come from households and commercial entities and don't have a stated maturity. Banks rely on them because of their added stability.

**A is incorrect:** Saving Deposits are non-transactional and may have defined terms but do not fit the described criteria.

**C is incorrect:** Certificates of Deposit (CDs) offer pre-set maturity and interest rates and do not match the given description



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## LOS 4b: describe repurchase agreements (repos), their uses, and their benefits and risks

Repurchase agreements, commonly known as repos, serve as a secured method for short-term borrowing and lending. These transactions consist of a seller committing to repurchase a security at a predefined price on a future date. This operation essentially allows the seller to obtain a short-term loan collateralized by the security.

The repo transaction starts with the sale of a security and ends with its repurchase. For instance, consider a US five-year Treasury note trading at $150 million. If it's sold today (t=0) under a 45-day repo term at an annual interest rate (repo rate) of 0.5%, the repurchase price after 45 days would be calculated as:

Assuming that there are 360 days in a year:

$$150 \times [1 + (0.5\% \times \frac{45}{360})] = \$150.094 \text{ million}$$

The security seller effectively gets a short-term loan, collateralized by the US Treasury note. Repos can range from overnight to term repos, which have maturities longer than a day. The most common collateral is highly liquid bonds with minimal credit risk, such as sovereign bonds. A general collateral repo transaction allows a range of securities as eligible collateral.

## Features and Calculations

Repos may require collateral in excess of the cash exchanged, termed as initial margin.

$$\text{Initial margin} = \frac{\text{Initial security price}}{\text{Initial purchase price}}$$

A loan that's backed entirely by collateral has a 100% initial margin. If the margin is greater than this, it indicates that there's even more collateral provided initially. You can think of this extra collateral as a “haircut” or reduction to the loan in comparison to the starting value of the collateral. The equation representing this concept is:



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$$\text{Haircut} = \frac{(\text{Initial Security Price} - \text{Purchase Price at the start})}{\text{Initial Security Price}}$$

Repos adapt to fluctuations in collateral value by allowing those involved in the contract to either ask for more collateral or give back some of what they've already provided. This ensures that the security interest remains consistent with the originally agreed-upon margin terms. This fluctuating margin payment, known as the variation margin, measures the gap between the current required margin and the value of the security at a specific time, which is represented in the following equation:

$$\text{Variation margin} = (\text{Initial margin} \times \text{Purchase price at time t}) - \text{Security Price at time t.}$$

## Uses of Repos

i. Financing Securities: Institutions that trade or hold securities, such as banks, often use the repo market to finance their security ownership. It enables them to manage their cash flow efficiently without selling the asset.
ii. Secured Lending: From the perspective of the buyer in a repo transaction, it's an opportunity to lend funds on a short-term basis with the added security of collateral, thus minimizing default risk.
iii. Short Selling: Some entities utilize repos to borrow securities for short selling, a strategy where the borrower believes the asset price will decrease.

## Benefits of Repos

i. Liquidity: Repos provide immediate liquidity, making them invaluable for institutions requiring short-term funds.
ii. Security: Repos are collateralized, meaning the risk of default is lower compared to unsecured loans.
iii. Flexibility: With durations ranging from overnight to longer-term, repos can cater to diverse liquidity needs.
iv. Central Bank Operations: Central banks use the repo market as a tool for implementing monetary policy, allowing them to manage liquidity in the banking system.



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## Risks Associated with Repos

i. Default Risk: Despite being secured, there remains a risk of default. If a party fails to meet its obligations, the other party might suffer losses, especially if the collateral's value has depreciated.
ii. Collateral Risk: The quality, liquidity, and value of the collateral can fluctuate. If a party defaults, the other might find it challenging to liquidate the collateral at the expected value.
iii. Margining risk: It's crucial to ensure accurate and prompt valuation of collateral and the transfer of variation margin. This helps prevent collateral deficiencies if there's a need to liquidate after a default. Moreover, unfavorable market situations might lead to significant shifts in collateral's value, amplifying margin requirements and prompting more liquidations among traders.
iv. Legal risk: This pertains to the enforceability of rights within a repurchase agreement.
v. Netting and settlement risk: This involves the capability of those involved in a repo contract to either offset the duties of a party that hasn't defaulted and to claim either collateral or cash as a trade settlement.

## Risk Management

Repo market players often involve a third party for risk management. Direct transactions between two entities are termed bilateral repos. On the other hand, triparty repos involve a third-party agent agreed upon by both main parties. The triparty agent, such as a custodian, oversees the transaction, including cash, securities, collateral valuation, and safekeeping. Triparty agents enable cost efficiencies, larger collateral pools, and access to multiple counterparties. Although the repo market is stable, it poses significant rollover and liquidity risks, especially during adverse conditions. Financial institutions must weigh the affordability of repo funding against the flexibility of pricier long-term financing methods. While repo transactions are collateralized, they've led to significant losses during crises due to over-reliance on repo financing by some firms.



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## Question #1

Assume that today (t=0) the current US ten-year Treasury note trades at a price equal to the bond's face value of USD150,000,000. The security buyer takes delivery of the US Treasury note today and pays the security seller a purchase price based on an initial margin of 104%. The repo haircut is closest to:

A. 0.00%

B. 3.85%

C. 4.00%

**Solution**

The face value of the US ten-year Treasury note = USD150,000,000.

Initial margin =104%

Now, the "Purchase Price" can be found using the formula:

$$\text{Purchase Price} = \frac{\text{Security price}}{\text{Initial Margin}}$$

$$\text{Purchase Price} = \frac{\text{USD } 150,000,000}{1.04} = \text{USD } 144,230,769.23$$

Now, the repo haircut is defined as:

$$\text{Haircut} = \left(\frac{\text{Initial Security Price} - \text{Purchase Price}}{\text{Initial Security Price}}\right) \times 100\%$$

Inserting our values:

$$\text{Haircut} = \left(\frac{\text{USD } 150,000,000 - \text{USD } 144,230,769.23}{\text{USD } 150,000,000}\right) \times 100\% = 3.85\%$$

## Question #2

Which of the following best describes the primary use of a repurchase agreement (repo)



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in the context of financial institutions?

A. Hedging against exchange rate fluctuations.
B. Financing their security ownership.
C. Securing long-term funding for capital expenditure.

**Solution**

**The correct answer is B:**

Financial institutions often use the repo market to finance their security ownership, which enables them to manage their cash flow efficiently without selling the asset.

**A is incorrect:** Hedging against exchange rate fluctuations is not the primary use of repos.

**C is incorrect:** Repurchase agreements are primarily for short-term funding, not long-term capital expenditure.

## Question #3

What are the inherent risks associated with repurchase agreements?

A. Inflation risk, currency risk, and equity risk.
B. Default risk, collateral risk, and legal risk.
C. Commodities risk, strategic risk, and liquidity risk.

**Solution**

**The correct answer is B:**

Repos come with risks such as default risk (if a party fails to meet its obligations), collateral risk (related to the quality, liquidity, and value of the collateral), and legal risk (related to the enforceability of rights within a repurchase agreement).

**A is incorrect:** Inflation risk, currency risk, and equity risk are more general market risks and not specifically inherent to repos.



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**C is incorrect:** While liquidity risk is a concern for the repo market, commodities risk and strategic risk aren't primary risks associated with repurchase agreements.



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### LOS 4c: contrast the long-term funding of investment-grade versus high-yield corporate issuers

Corporate issuers use long-term debt to secure stable funding for a range of requirements, from short-term operations to long-term capital investments. However, the features and availability of such funding vary based on the credit quality of the issuer. While IG corporate issuers showcase a strong capacity to meet future obligations, HY issuers are vulnerable in meeting debt interest and principal payments.

## Similarities between IG & HY Issuance

Both IG and HY issuers are confronted with a series of considerations when issuing long-term debt. They weigh the relative risk against its costs or yield-to-maturity of long-term debt of different maturities. Moreover, both categories of issuers need to address concerns associated with interest rates, credit spreads, and maturity choices. The overarching issues of price risk, reinvestment risk, and rollover risk further bind these issuers in their decision-making process.

## Distinguishing Features of IG and HY Bonds

### Investment-Grade Bonds

- IG bonds often possess a lower proportion of YTM that's attributed to credit spreads.
- These bonds come with fewer restrictions for issuers, primarily because they're less likely to default.
- Cash flows from IG bonds are more predictable, aligning more with traditional bond characteristics.

### High-Yield Bonds

- Their cash flows resemble equity investments, carrying an inherent uncertainty.



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- A significant portion of their YTM is credited to issuer-specific spreads over benchmark yields, owing to the increased likelihood of default.
- These bonds often come laden with restrictions, and many are secured by tangible assets to appease wary investors.

## Analytical Approach to IG and HY Bonds

For IG Bonds, analysts typically lean on financial ratios and credit ratings to gauge the potential shift in an IG issuer's likelihood of default. On the other hand, given their high-risk profile, HY bonds demand a more intricate analysis. Emphasis is placed on evaluating potential losses in the event of default. Moreover, analysts closely examine covenants, restrictions, and security pledges tied to HY bonds.

## Bond Maturities and Restrictions

Investment-Grade Bonds:

- IG issuers have a high flexibility in choosing maturities (up to 30 years).
- Their bonds typically carry few, if any, restrictive covenants.

High-Yield Bonds:

- Their landscape is more restrictive, marked by shorter maturity horizons, usually capped at 10 years.
- Given their risk profile, these issuers often find themselves renegotiating covenants or restructuring their debt to capitalize on favorable borrowing rates.

## Investor and Issuer Implications

Investment-Grade Bonds:

- There is a high investor confidence in the IG issuer's ability to meet obligations.



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- Typically, IG issuers circulate multiple general obligation unsecured bonds. These bonds lack specific assets as collateral.
- IG Issuers stagger bond maturities across different periods. This strategy aids in risk minimization and ensures consistent capital availability.

High-Yield Bonds:

- HY bonds display unpredictable cash flows, similar to equity investments. This volatility stems from the issuer's comparatively weaker financial standing.
- To mitigate default risks, HY bonds incorporate restrictive covenants. These covenants impose guidelines to safeguard investors.
- HY issuers operate within stringent frameworks. They confront challenges in issuing additional debt and experience marked fluctuations in credit spreads.
- HY issuers, aiming for financial adaptability, explore diverse borrowing options. They often resort to leveraged loans with prepayment features or bonds with contingency provisions.

## Fallen Angels

A unique subset within the high-yield universe is the “fallen angels” issuers. These are formerly investment-grade issuers who experienced a decline in their credit rating. However, their bonds still retain features characteristic of investment-grade instruments. These features include being non-callable, having minimal restrictions, and possessing longer maturities. However, any subsequent deterioration in the issuer's credit quality can precipitate losses for the original investors. This decline is further exacerbated by the fact that the market for high-yield bonds is significantly smaller compared to the market for investment-grade bonds, which can have a pronounced effect on bond prices.



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## Question #1

In terms of maturities, which bond issuer typically has the flexibility to choose maturities that can extend up to 30 years?

A. High-Yield Bonds
B. Fallen Angels
C. Investment-Grade Bonds

**Solution**

**The correct answer is C:**

Investment-Grade Bonds issuers have the flexibility in choosing maturities, and these can extend up to 30 years.

**A is incorrect:** High-Yield Bonds often have a more restrictive landscape, usually limited to maturities of 10 years.

**B is incorrect:** While Fallen Angels might retain some features of investment-grade instruments after a credit rating downgrade, the question specifically refers to the typical maturity of a particular type of bond, not a subset of issuers.

## Question #2

In the context of credit quality, which of the following bonds typically carries a significant portion of its yield-to-maturity (YTM) attributed to issuer-specific spreads over benchmark yields?

A. Bonds with predictable cash flows
B. Investment-Grade Bonds
C. High-Yield Bonds

**Solution**



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**The correct answer is C:**

High-Yield Bonds typically have a significant portion of their YTM credited to issuer-specific spreads over benchmark yields due to the increased likelihood of default.

**A is incorrect:** The predictability of cash flows does not directly determine the portion of YTM associated with issuer-specific spreads.

**B is incorrect:** Investment-Grade Bonds generally have a lower proportion of their YTM attributed to credit spreads, reflecting their lower default risk.



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# Learning Module 5: Fixed Income Market for Government Issuers

## LOS 5a: describe funding choices by sovereign and non-sovereign governments, quasi-government entities, and supranational agencies

## National or Sovereign Government Issuers

National governments possess the sovereign authority to derive tax cash flows from economic activities within their jurisdiction. In contrast, private sector issuers depend on operating cash flows and alternative repayment sources, such as asset sales, to fulfill their debt responsibilities. Debt obligations of national issuers can also be repaid using tariffs, usage fees, and revenues from government-owned enterprises.

The role of national versus regional or local governments varies greatly among different markets, as does the extent of government participation in the economy. While private issuers use GAAP to prepare financial statements, public sectors might use different financial accounting standards, often based on cash rather than accrual principles. An economic balance sheet is more relevant for public sector issuers as it accounts for expected future claims and obligations.

The size of the government sector in relation to a country's economy differs greatly among nations. Additionally, the responsibilities shared between national governments, quasi-government agencies, and local governments can also vary. Consequently, non-sovereign issuers may emerge in the same jurisdiction as the sovereign issuer.

### Developed Vs. Emerging Sovereign Issuers

### Developed Market (DM) Sovereign Issuers

DMs typically have a strong, diversified, and stable domestic economy. Their national government budgets consist mainly of consistent outlays funded through comprehensive individual and business tax revenues, ensuring a stable and transparent fiscal policy. Their fixed-income securities are often in major currencies held as reserves by other nations. This allows DM sovereigns to issue what's generally regarded as default-risk-free debt, accessible across various maturities.



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## Emerging Market (EM) Sovereign Issuers

EM economies usually experience higher growth, but they may be less stable and diversified. These economies might be more susceptible to the economic cycle's ups and downs and may rely on a primary domestic industry or commodities. Their central government budgets might prioritize investment in economic and social infrastructure that exceeds the current domestic tax revenues, leading to external or supranational funding requirements. Their sovereign debt securities could be in a restricted domestic currency or one with limited convertibility. Investors in developed markets who purchase these bonds face indirect exposure to currency fluctuations.

## Domestic Debt vs. External Debt

Domestic debt is denominated in the country's own currency. For emerging market sovereign issuers, it's notable that domestic entities predominantly take up such debts. Financial institutions within the country, along with other local investors, are the primary holders of these bonds. By being in the domestic currency, the direct risk associated with currency fluctuations is minimized for these investors. Essentially, the risk of repayment doesn't hinge on the volatile exchange rates or international market dynamics to the same degree as it does with external debt.

On the other hand, external debt pertains to obligations owed to foreign creditors. This kind of debt can come from various sources. For instance, supranational financial organizations often lend to emerging market nations. Additionally, there are sovereign Eurobonds, such as the euro-denominated bond from Romania or the US dollar-denominated bond from the quasi-government PT Indonesia Infrastructure Finance. These bonds, being in foreign currencies, are primarily held by foreign private investors.

Investors from developed markets purchasing external debts of emerging countries don't directly encounter risks from the domestic currency's fluctuations. However, they still face indirect currency risks. Their returns largely depend on the issuing country's ability to generate foreign currency revenue from international capital, goods, and services flows, ensuring the timely settlement of foreign currency interest and principal payments. The government of Sri Lanka serves as a significant example of the challenges tied to managing such external debts.



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## Government Debt Management

A country's fiscal policy determines its level of sovereign debt by comparing government spending, including budget requirements and debt service costs, against tax receipts, fees, and other revenue sources. Debt levels are influenced by budget deficits and surpluses. Projections must account for fiscal policy changes and the impact of economic growth and inflation on expenditures and revenues.

Governments have to strategize the composition of their debt, taking into consideration the short versus long term. Sovereign debt could encompass short-term securities like Treasury bills, and medium to long-term securities such as Treasury notes and bonds. Some governments might guarantee other instruments, effectively treating them as a form of sovereign debt, with mortgage-backed securities being a notable example.

National governments usually represent the lowest default risk and are typically the largest bond issuers in a domestic market. The Ricardian equivalence theorem suggests that a government's debt maturity choice doesn't affect the present value of future tax cash flows. It makes the following assumptions:

i. Taxpayers save for future tax payments.
ii. Capital markets are assumed to be perfect, with no transaction costs.
iii. Taxpayers have rational expectations about future taxes.
iv. Intergenerational altruism by taxpayers, where they leave their tax benefits to their offspring.

However, when these assumptions are relaxed, it results in debt management policies that offer various benefits to both investors and other issuers.

Government bond issuance in both the short and long term should strike a balance between higher borrowing costs and fiscal stability, considering the benefits of providing low default risk across maturities. The benefits of long-term sovereign bond issuance are as outlined below:

i. Establishing risk-free benchmarks for specific maturities: Government debt policies issue benchmark securities across various maturities to enhance capital market efficiency. These benchmarks, derived from sovereign bond yields, set a standard to measure the



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creditworthiness of other issuers.

ii. Managing and hedging against market interest rate risks: Medium to long-term government securities and their derivatives are tools used by financial intermediaries and asset managers to manage the volatility of interest rates, separating it from credit risk.

iii. Serving as referred collateral in various transactions: Long-term government securities are favored as collateral in transactions like repos due to their high liquidity and safety. These offer sellers financing avenues and buyers a collateralized, low-risk investment.

iv. Assisting in monetary policies and foreign exchange reserves: Central banks utilize government securities for monetary policy implementation, including buying and selling these securities. Additionally, their liquidity and safety make them a top choice for foreign currency reserves held by foreign market participants.

## Non-Sovereign Governments

Within a given jurisdiction, it is common to have non-sovereign issuers alongside the national or sovereign government. These non-sovereign issuers often encompass regional or local governments. Their funding varies, depending on whether they provide services at the national, regional, or local level. Some have the capability to levy taxes similar to sovereign entities, while others rely on national government budget allocations or user fees. The stability of their income streams often determines their access to different funding avenues.

## Quasi-Government Organizations

Quasi-government entities can be thought of as entities that operate in the private sector but have a government's backing or ownership. They typically serve purposes that might not be immediately profitable but are deemed necessary for the public good. This could range from national airlines to housing authorities. Since these entities have some degree of government backing, their debt is often considered less risky than that of purely private entities but riskier than direct sovereign debt.

## Local and Regional Government Authorities



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These non-sovereign government authorities might issue debt either for general objectives, financed by local taxes, or for specific projects, repaid through user fees or other directly related revenues. General obligation bonds (GO bonds), for instance, help finance public goods and services within a limited jurisdiction. On the other hand, revenue bonds are targeted at specific infrastructure projects, with repayment often tied to the project's revenue, like tolls from bridges or roads.

## Supranational Agencies

Supranational agencies stand distinct from sovereign and non-sovereign issuers. They are formed by international agreements and are usually constituted by multiple nations coming together for a common purpose. Examples of such agencies include the World Bank, International Monetary Fund (IMF), and regional development banks. Their main goal is often to provide funding for projects that promote economic development or integration across member nations.

When supranational agencies issue debt, it is backed by the commitments of its member nations. This often means that their bonds come with a very high degree of creditworthiness, given the diverse backing from multiple national governments. However, they aren't entirely risk-free. The risk associated with these bonds is tied to the collective economic health of the member countries and the specific projects they fund.



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## Question #1

Why might the debt of supranational agencies, such as the World Bank, be considered to have a high degree of creditworthiness?

A. Their debt is exclusively funded by developed market sovereign issuers.
B. Their bonds are backed by the commitments of their member nations.
C. They issue debt only in major currencies held as reserves by other nations.

**Solution:**

**The correct answer is B:**

The debt of supranational agencies is backed by the commitments of its member nations, which gives their bonds a high degree of creditworthiness.

**A is incorrect:** While developed market sovereign issuers might be significant contributors, they aren't exclusive funders.

**C is incorrect:** The currency in which the debt is issued does not necessarily correlate directly with the creditworthiness of the agency.

## Question #2

Which of the following best describes the primary purpose of a quasi-government entity?

A. To govern and derive tax cash flows from economic activities.
B. To provide funding for projects promoting economic development across multiple nations.
C. To serve specific public needs, such as infrastructure development, that may not be immediately profitable but are deemed essential for the public good.

**Solution**

**The correct answer is C:**



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Quasi-government entities are entities that operate in the private sector but have government backing. They typically serve purposes that might not be immediately profitable but are necessary for the public good.

**A is incorrect:** This describes the role of national or sovereign governments.

**B is incorrect:** This describes the role of supranational agencies like the World Bank.

## Question #3

Which of the following best differentiates developed market (DM) sovereign issuers from emerging market (EM) sovereign issuers?

A. DM sovereign issuers typically have a volatile and undiversified domestic economy, whereas EM issuers have a stable, diversified economy.
B. DM sovereign issuers primarily focus on external or supranational funding requirements, while EM issuers fund through comprehensive individual and business tax revenues.
C. DM sovereign issuers generally have a stable and diversified domestic economy with transparent fiscal policies, while EM issuers may rely more on a primary domestic industry or commodities.

**Solution**

**The correct answer is C:**

Developed Market sovereign issuers typically have a strong, diversified, and stable domestic economy with transparent fiscal policies. In contrast, Emerging Market issuers might be more susceptible to economic cycles and may depend on a dominant domestic industry or commodities.

**A is incorrect:** This statement reverses the characteristics of DM and EM issuers.

**B is incorrect:** EM issuers might prioritize infrastructure investments that exceed current domestic tax revenues, leading them to seek external or supranational funding.



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## LOS 5b: contrast the issuance and trading of government and corporate fixed-income instruments

# Sovereign vs. Corporate Debt Issuance Process

There is a clear distinction between corporate and sovereign debt issuance processes. Corporate debt issuance tends to be opportunistic and is managed by investment bank underwriters on behalf of the issuers. On the other hand, sovereign debt typically follows the form of a public auction, often led by the National Treasury or finance ministry.

When a government announces a debt auction, it opens the door for prospective investors to place either *competitive* or *non-competitive* bids. A competitive bidder specifies both the price they are willing to pay and the number of securities they wish to acquire. Should the auction's final price exceed the bidder's set price, the competitive bidder walks away empty-handed. In contrast, a non-competitive bidder forgoes the price-setting privilege and agrees to whatever price the auction settles at, but with the assurance of always receiving the securities.

## Competitive Bid Processes

There are two primary mechanisms for the competitive bid process: the single-price auction and the multiple-price auction. Both processes require the issuer to rank bids based on their prices. Starting from the highest, bids are selected until the entire issuance amount has been met. In a single-price auction, each winning bidder pays an identical price and receives the same coupon rate, regardless of their initial bid. The multiple-price auction, in contrast, might result in varied prices among bidders for the same bond issue. While the single-price approach could lead to a lower cost of funds and a diverse investor base, the multiple-price auctions might end up with a concentration of large bids.

## Single-Price Auction Phases

1. Announcement by the government debt management office detailing the bond issue.
2. Submission of bids, either competitive or non-competitive, by dealers, institutional investors, and individuals.
3. Acceptance of all non-competitive bids; ranking of competitive bids from the lowest yield.



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Determination of the cut-off yield.

4. Delivery of securities to the successful bidders in exchange for proceeds.

## Role of Financial Intermediaries in Sovereign Debt

Sovereign governments often appoint a group of primary dealers, financial intermediaries mandated to participate in all auctions. These primary dealers can also be counterparts for central banks in open market operations and help facilitate foreign central bank transactions. Additionally, investors might also directly participate in auctions through specific national platforms.

## Trading of Sovereign vs. Corporate Debt

Sovereign debt, once issued, is primarily traded on Over-The-Counter (OTC) markets through financial intermediary brokers/dealers. However, in some places, like Australia, it is traded on exchanges. In most markets, the sovereign issuer is the primary borrower, and their securities are the most liquid in the fixed-income category. The most recent sovereign debt securities, termed "on-the-run" securities, stand out for their liquidity, making them pivotal for benchmark yield analyses. These contrast with older, less frequently traded "off-the-run" securities. Because of their high liquidity, some of "on-the-run" securities are traded on electronic platforms managed by private entities.

## Investors in Sovereign Debt Vs. Corporate Debt

Sovereign debts often attract investors with varying non-economic objectives. For instance, the Federal Reserve uses US Treasuries for monetary policy, while certain governments use them as dollar reserves. Some entities, like banks and insurance companies, may need to hold Treasuries to meet specific regulatory requirements. Such factors can reduce sovereign borrowing costs compared to the private sector, especially for issuers with a reserve currency. Reserve currencies are those held by central banks globally, e.g., the US dollar, Euro, pound, etc. They are used for international trade and financial transactions.



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## Question #1

Which category of sovereign debt securities is *most likely* known for their high liquidity and is essential for benchmark yield analyses?

A. Off-the-run securities
B. On-the-run securities
C. Exchange-traded securities

**Solution**

The correct answer is **B.**

"On-the-run" securities are the most recent sovereign debt securities, known for their liquidity, making them pivotal for benchmark yield analyses.

**A is incorrect:** "Off-the-run" securities are older and less frequently traded.

**C is incorrect:** While some sovereign debt might be traded on exchanges (e.g., in Australia), this choice does not pertain to the liquidity and benchmarking aspect described in the notes.

## Question #2

Which type of auction *most likely* result in varied prices among bidders for the same bond issue?

A. Single-price auction
B. Non-competitive auction
C. Multiple-price auction

**Solution**

The correct answer is **C.**



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The multiple-price auction might result in varied prices among bidders for the same bond issue.

**A is incorrect:** In a single-price auction, all winning bidders pay the same price.

**B is incorrect:** Non-competitive bidders agree to pay whatever price the auction settles at, and therefore there is no variation in price among them.

## Question 3

Where are most sovereign debt securities primarily traded after issuance?

A. Stock exchanges
B. Over-The-Counter (OTC) markets
C. Online public auction platforms

**Solution**

The correct answer is **B.**

Sovereign debt, once issued, is primarily traded on Over-The-Counter (OTC) markets through financial intermediary brokers/dealers.

**A is incorrect:** Though some sovereign debt, like in Australia, is traded on exchanges, the majority is traded OTC.

**C is incorrect:** Online public auction platforms might be used for issuing or buying the debt but not primarily for trading after issuance.



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## Learning Module 6: Fixed Income Bond Valuations: Prices and Yields

### LOS 6a: calculate a bond's price given a yield-to-maturity on or between coupon dates

# Bond Price Calculation

The price of a bond is influenced by various factors, including its cashflow features and market discount rate. The cash flow features are periodic payments made to bondholders, such as interest or coupon payments. On the other hand, the market discount rate is the required return based on the bond's risk. It reflects investors' expectations and the time value of money. At issuance, the bond price equals the present value (PV) of future interest and principal cash flows.

The price of a bond can be determined using mathematical formulas or spreadsheet functions as highlighted below:

Bond price: $P = \sum_{t=1}^{N} \left(\frac{C_t}{(1+r)^t}\right) + \frac{FV_N}{(1+r)^N}$

Where:

- r = Market discount rate
- $C_t$ = Coupon payment at time t
- N = number of periods until maturity
- FV = Face value of the bond
- PV of Bond coupon = $\left(\frac{C_t}{(1+r)^t}\right)$
-

Spreadsheet Function for Bond Price: Bond Price=PV (rate, nper, pmt, FV, type)

Where:

- rate is the market discount rate per period.



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- nper is the number of periods
- pmt is the coupon payment per period
- FV is the face value
- type refers to whether payments are made at the end (0) or beginning (1) of each period

### Types of Bonds

Bonds are categorized into three main types, each representing a specific relationship between price, coupon rate, and market discount rate:

- **Par bond:** Price equals future value; coupon rate equals the market discount rate.
- **Discount bond:** Price is less than future value; coupon rate is less than the market discount rate.
- **Premium bond:** Price is greater than future value; coupon rate is greater than the market discount rate.

## Yield-to-Maturity (YTM)

Yield-to-Maturity (YTM) represents the bond's internal rate of return (IRR), which is the single, uniform interest rate that, when applied to discount the bond's future cash flows, equals the current price of the bond. In essence, YTM is the implied or observed market discount rate. It is also known as the bond's "promised yield," assuming the issuer does not default. YTM ("yield") is used interchangeably with market discount rate or required yield.Instead of discussing bond prices, market participants might say "yields are rising" to mean "market discount rates are rising" or "bond prices are falling."

### Conditions for Earning YTM

An investor will achieve a return equal to the YTM if the following conditions are met:



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- Holding the bond until maturity.
- The issuer making full coupon and principal payments on the scheduled dates.
- Reinvesting all coupon payments at the YTM.

## YTM Calculation

The formula for calculating YTM is as follows:

$$P = \frac{C}{(1+r)^1} + \frac{C}{(1+r)^2} + \ldots + \frac{C+F}{(1+r)^n}$$

Where:

- P = Price of the bond.
- C = Periodic coupon payment.
- r = Yield to maturity.
- F = Face value of the bond.
- n = Number of periods until maturity.

## Using Spreadsheet Functions

YTM can be calculated using specific functions in spreadsheet tools like Microsoft Excel or Google Sheets:

**YIELD Function:**

=YIELD(settlement, maturity, rate, pr, redemption, frequency, [basis])

Where:

- settlement = Settlement date.
- maturity = Maturity date.



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- rate = Semi-annual (or periodic) coupon.
- pr = Price per 100 face value.
- redemption = Future value at maturity.
- frequency = Number of coupons per year.
- [basis] = Day-count convention (optional).

**IRR Function:** YTM can also be calculated using the IRR function in these tools, as it represents an internal rate of return.

## Example: Bond Price Calculation

A municipal bond that matures on 1 July 2040 pays semiannual coupons of 2.75% per year and has a face value of 100. The market discount rate is 3.5%. For a trade settlement date of 1 July 2035, the price of the bond as a percentage of par value, assuming a 30/360-day count, is closest to:

### Solution

The bond price is the sum of the coupon and principal payments discounted at the market discount rate.

$$PV = \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \cdots + \frac{C_N + FV_N}{(1+r)^N}$$

- C=1.375, i.e., $\frac{2.75\%}{2} \times 100$
- r $= \frac{3.5\%}{2} = 0.0175$
- FV=100
- N=10, since payments are made twice a year for 5 years

$$PV = \frac{1.375}{(1+0.0175)^1} + \frac{1.375}{(1+0.0175)^2} + \frac{1.375}{(1+0.0175)^3} + \ldots + \frac{101.375}{(1+0.0175)^{10}} = 96.587$$



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## Flat Price, Accrued Interest, and the Full Price

In bond trading, especially when a bond is priced between coupon payment dates, three key components are considered: the flat price, accrued interest, and the full price.

1. **Flat Price** The flat price, also known as the quoted or "clean" price, represents the price of the bond without considering any accrued interest.
2. **Accrued Interest** Accrued interest is the interest that has accumulated since the last coupon payment but has not yet been paid. It is computed by considering the fraction of the coupon period that has elapsed. Formula for Accrued Interest:

$$AI = \frac{t}{T} \times PMT$$

Where:

- $t$ = Number of days from the prior coupon payment to the settlement date.
- $T$ = Number of days in the coupon period.
- $PMT$ = Coupon payment per period.

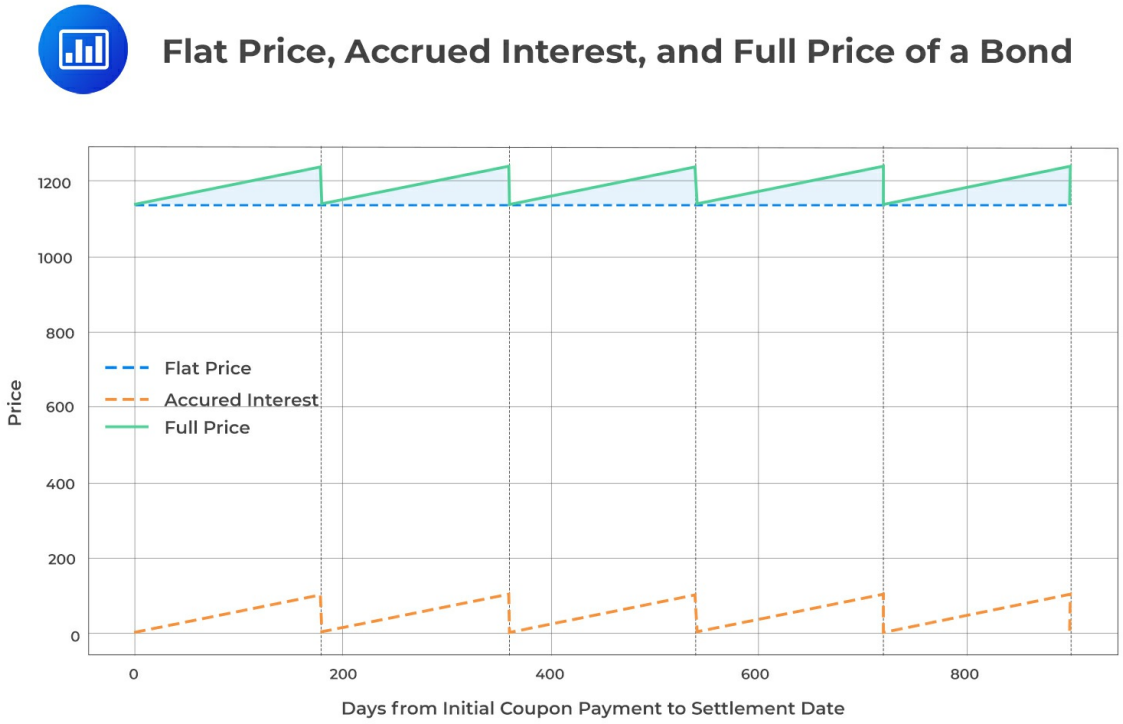
The graph below illustrates the relationship between the flat price, accrued interest, and full price of a bond over its entire lifetime, spanning multiple coupon periods.

1. **Flat Price (Dashed Line):** Represents the present value of the bond's future cash flows without considering accrued interest. It remains constant throughout the bond's lifetime.
2. **Accrued Interest (Dash-Dot Line):** Depicts the interest that has accumulated since the last coupon payment. It starts at zero at the beginning of each coupon period and linearly increases until the next coupon payment.
3. **Full Price (Solid Line):** The sum of the flat price and accrued interest. It follows the same pattern as accrued interest but starts from the flat price level at the beginning of each coupon period.
4. **Vertical Lines (Dotted Grey Lines):** Indicate the end of each coupon period, marking the moments when coupon payments are made.



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The shaded area between the flat price and full price lines visually represents the accrued interest at any given point in time. This graph provides a clear understanding of how these key components of bond pricing interact and evolve over time.




1. **Full Price**The full price, or "dirty" price, is the sum of the flat price and the accrued interest. Full Price of a Fixed-Rate Bond is expressed as:

$$PV_{Full} = \frac{C}{(1+r)^{1-t/T}} + \frac{C}{(1+r)^{2-t/T}} + \ldots + \frac{C+FV}{(1+r)^{N-t/T}}$$

Where:

- C = Coupon payment per period.
- r = Market discount rate per period.
- t = Number of days from the prior coupon payment to the settlement date.
- T = Number of days in the coupon period.



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- N = Total number of periods.
- FV = Face value of the bond.

Day count conventions specify how days are counted within a period. 30/360 assumes 30 days in a month and 360 days in a year. On the other hand, Actual/Actual uses the actual number of days in a month/year.

## Example: Calculating the Flat Price

A certain bond pays semiannual coupons of 2.0% per year on 30 June and 31 December each year, with a face value of 100. The YTM is 2.5%. The bond is purchased and will settle on 15 September, when there will be four coupons remaining until maturity. The flat price of the bond as a percentage of par value, assuming an actual/actual day count, is closest to:

## Solution

- PMT = 1.00, i.e., $2\% \times \frac{100}{2}$
- r = 0.0125 (2.5% annual market discount rate, divided by 2 for semiannual)
- t = 77 (days from 30 June to 15 September)
- T = 184 (days from 30 June to the next coupon on 31 December)
- FV = 100
- N = 4 (remaining coupons)

$$PV^{Flat} = PV^{Full} - AI$$

$$PV^{Full} = \left[\frac{PMT}{(1+r)^1} + \frac{PMT}{(1+r)^2} + \ldots + \frac{PMT + FV}{(1+r)^N}\right] \times (1+r)^{\left(\frac{t}{T}\right)}$$

$$PV^{Full} = \left[\frac{1}{(1.0125)^1} + \frac{1}{(1.0125)^2} + \frac{1}{(1.0125)^3} + \frac{1+100}{(1.0125)^4}\right] \times (1.0125)^{\left(\frac{77}{184}\right)} = 99.547$$

$$AI = \frac{77}{184} \times 1.00 = 0.418$$

$$PV^{Flat} = 99.547 - 0.418 = 99.129$$



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## Question

A bond that matures on 1 July 2040 pays semiannual coupons of 2.5% per year and has a face value of 100. The market discount rate is 4.0%. For a trade settlement date of 1 July 2038, the price of the bond as a percentage of par value is closest to:

A. 94.555
B. 90.018
C. 97.144

## Solution

**The correct answer is C:**

Using the given values:

$PMT = 1.25$, i.e.,

$r = 0.020$ (4% annual market discount rate, divided by 2 for semiannual)

$FV = 100$

$N = 4$ (Since payments are made twice a year for 2 years)

Formula for bond price:

$$PV = \frac{C}{(1+r)^1} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \frac{(C+FV)}{(1+r)^4}$$

$$PV = \frac{1.25}{(1.020)^1} + \frac{1.25}{(1.02)^2} + \cdots + \frac{101.25}{(1.020)^4} = 97.144$$



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## LOS 6b: identify the relationships among a bond’s price, coupon rate, maturity, and yield-to-maturity

# Inverse Relationship – Bond Price and YTM

The price of a bond and the yield-to-maturity have an inverse relationship. The same is shown in the blue line in the figure below for a bond with a maturity of 5 years and a coupon rate of 4%. A higher discount rate (or yield) lowers the present value of the fixed future cash flows, thereby reducing the bond's price (moving right along the blue line). Conversely, a lower discount rate (or yield) increases the present value of the fixed future cash flows, resulting in a higher bond price (moving left along the blue line).

This inverse relationship reflects the natural fluctuation in the value of money over time and is central to understanding bond pricing and valuation.

### The Coupon Effect

The size of the bond coupon affects the price change for a given yield change. The coupon effect is illustrated by the red dashed line in the figure, representing the fixed coupon rate of 4%. The lower a bond's coupon, the higher the proportion of total cash flow that occurs at maturity. This makes the bond more susceptible to changes in the yield-to-maturity, as the final cash flow is magnified by the discount factor of $(1 + r)^N$. On the other hand, a higher coupon bond provides more periodic interest payments, reducing the impact of yield changes on the bond's price.

### Maturity Effect

Longer-term bonds experience greater percentage price change than shorter-term bonds for the same change in market discount rates. This heightened sensitivity is due to the higher number of periods (N) until maturity in the bond pricing equation for the longer-maturity bond. The maturity effect is shown by the green dashed line in the figure, representing the yield to maturity at which the bond is priced at par value.

Although the maturity effect applies broadly, exceptions do exist and usually apply to low-coupon

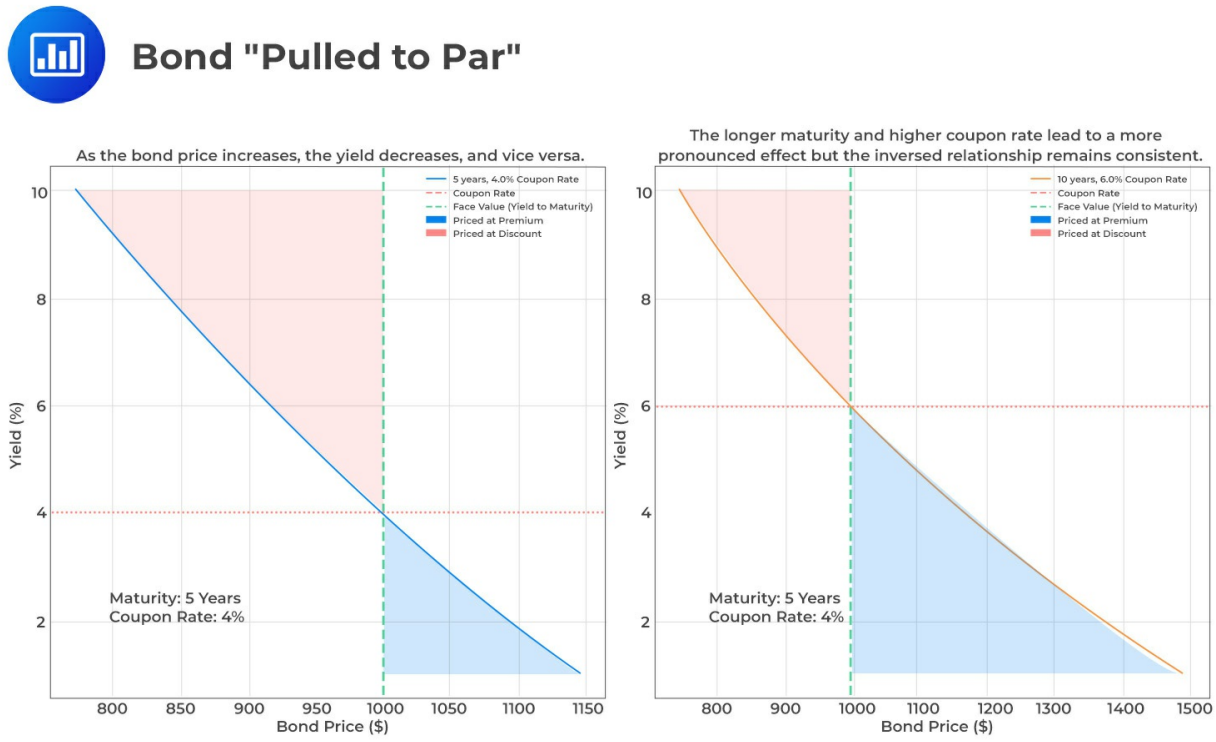


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long-term bonds trading at a discount. However, it consistently holds for zero-coupon bonds and for bonds priced at or above par value, making it a valuable tool in bond analysis.

## Constant-Yield Price Trajectory

The constant-yield Price Trajectory is shown by the shaded regions in the figure. As the bond's maturity date approaches, the bond's price gradually converges toward the par value (green dashed line). The light blue region shows where the bond is priced at a premium, and the light red region shows where it's priced at a discount. This phenomenon, known as being "pulled to par," illustrates the dynamic nature of bond pricing.




## Convexity Effect

The convexity effect explores the non-linear relationship between a bond's price and its yield. This relationship is clearly visible in the figure above, where the blue line representing the bond price versus yield curve is not a straight line but curved and convex.



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The Convexity Effect can be understood as follows:

- **Positive Convexity:** The curve's shape means that the percentage price increase for a bond (when yields fall) is greater, in absolute value than the percentage price decrease for an equivalent change in yield (when yields rise). This is beneficial to bondholders as they gain more when yields fall and lose less when yields rise.
- **Non-Linear Relationship:** The curve's convexity illustrates that the price-yield relationship is not directly proportional. As yields decrease, the price increases at an increasing rate, and as yields increase, the price decreases at a decreasing rate.

The convexity effect plays a vital role in bond portfolio management, as it helps in assessing the sensitivity of bond prices to changes in interest rates. It provides an added layer of understanding beyond simple duration measures, capturing the complex and non-linear dynamics of bond pricing.



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## Question #1

In terms of the maturity effect, how does a 30-year bond's percentage price change compare to a 5-year bond when market discount rates change by the same amount?

A. The 30-year bond experiences a lesser percentage price change.
B. The 30-year bond experiences the same percentage price change.
C. The 30-year bond experiences a greater percentage price change.

**Solution**

The correct answer is **C.**

In terms of the maturity effect, a 30-year bond will experience a greater percentage price change compared to a 5-year bond when market discount rates change by the same amount. This is because longer-maturity bonds have a greater duration, making them more sensitive to interest rate changes. The longer the time until maturity, the more significant the impact of a change in discount rates on the bond's present value.

**A is incorrect.** The 30-year bond will experience a greater, not lesser, percentage price change.

**B is incorrect.** The 30-year bond will not experience the same percentage price change as the 5-year bond; it will be more affected by changes in discount rates.

## Question #2

What does the constant-yield price trajectory illustrate as the bond's maturity date approaches?

A. The bond's price moves away from par value.
B. The bond's price fluctuates randomly.
C. The bond's price gradually converges towards the par value.



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**Solution**

The correct answer is **C.**

According to the coupon effect, a higher coupon rate reduces the impact of yield changes on a bond's price. With a higher coupon rate, a greater proportion of the bond's cash flow is realized earlier in the form of periodic interest payments, reducing the sensitivity of the bond's price to changes in yields.

**A is incorrect.** A higher coupon rate decreases, not increases, the impact of yield changes.

**B is incorrect.** The coupon rate does have an effect on the impact of yield changes; it is not unaffected.

## Question #3

How does the coupon effect relate to the proportion of total cash flow realized at maturity for a higher coupon bond?

A. The proportion of total cash flow realized at maturity is higher.
B. The proportion of total cash flow realized at maturity is unchanged.
C. The proportion of total cash flow realized at maturity is lower.

**Solution**

The correct answer is **C.**

The coupon effect relates to the proportion of total cash flow realized at maturity. For a higher coupon bond, the proportion of total cash flow realized at maturity is lower . This is because a higher coupon bond provides more of its cash flow earlier through periodic interest payments, reducing the proportion of cash flow realized at maturity.

**A is incorrect.** The proportion of total cash flow realized at maturity is lower for a higher coupon bond, not higher.

**B is incorrect.** The proportion is not unchanged; it is affected by the coupon rate.



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### LOS 6c: describe matrix pricing

## Matrix Pricing Process

Matrix pricing is a valuation method widely utilized by financial institutions to estimate the fair value of a security that is not actively traded. This process is especially significant for bonds and other fixed-income securities, which may not have regular market quotations. Unlike securities traded on major exchanges, many bonds are traded over the counter (OTC), leading to less transparent pricing. Matrix pricing addresses this challenge by leveraging observable market data and statistical techniques.

The core concept of matrix pricing involves identifying similar securities with known market prices and using them as a reference to estimate the value of the target security. By considering factors such as credit ratings, maturities, and coupon rates, matrix pricing draws a connection between securities that share similar characteristics. This enables a more robust and data-driven valuation process, even for securities that lack an active trading history.

Investment companies, mutual funds, and portfolio managers often rely on matrix pricing to maintain an accurate and up-to-date valuation of their holdings. The method aligns with fair value accounting principles and helps in achieving compliance with regulatory requirements. Furthermore, it contributes to a more transparent and realistic portrayal of a portfolio's value, thereby enhancing investor trust and confidence.

The graphical representation below provides an intuitive understanding of the matrix pricing process, illustrating how similar securities are identified, market data is observed, and interpolation or other statistical methods are applied to estimate the price of the target security:



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## Key Aspects of Matrix Pricing

- **Comparison with similar securities**: Matrix pricing involves using the prices of similar securities to determine the value of a security that is not actively traded. The left plot in the figure illustrates the yield curve of similar securities, and the target bond is highlighted in red.
- **Use of observable market data**: The process requires observable market data, such as interest rates and yield curves, as shown in both plots. The blue points represent similar securities with known yields and maturities.
- **Application in investment portfolios**: Mutual funds and other investment companies often use matrix pricing to value fixed-income securities, such as bonds, that may not be frequently traded.

## Steps in Matrix Pricing



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- **Identify similar securities**: The first step, as shown in the left plot, is to identify securities with similar credit ratings, maturities, and coupon rates.
- **Observe market data**: The next step, represented by the blue points, is to observe market data for the identified similar securities, including credit quality, yields, and maturities.
- **Estimate the price**: The right plot demonstrates how the price of the target bond is estimated. Using observed market data and interpolation (dashed red line) between the yields of adjacent similar securities, the price is estimated.

The figure above elucidates how matrix pricing leverages information from similar securities to estimate the price of a bond that may not be actively traded. The comparison with similar securities and the interpolation process are central to understanding this valuation method.

## Example: Estimating Illiquid Bond Price Using Matrix Pricing

An investment manager is estimating a price for an illiquid six-year, 3.5% annual coupon payment corporate bond. The manager identifies two corporate bonds that have similar credit quality: One is a five-year, 4.00% annual coupon payment bond priced at 105.25 per 100 of par value, and the other is a seven-year, 3.25% annual coupon payment bond priced at 103.50 per 100 of par value. Using matrix pricing, the estimated price of the illiquid bond per 100 of par value is closest to:

## Solution

The first step is to determine the yields-to-maturity on the observed bonds.

The required yield on the five-year, 4.00% bond priced at 105.250 is 2.858%.

$$105.250 = \frac{4.00}{(1+r)^1} + \frac{4.00}{(1+r)^2} + \frac{4.00}{(1+r)^3} + \frac{4.00}{(1+r)^4} + \frac{104.00}{(1+r)^5}$$

$$r = 2.858\%$$



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The required yield on the seven-year, 3.25% bond priced at 103.500 is 2.695%

$$103.500 = \frac{3.25}{(1+r)^1} + \frac{3.25}{(1+r)^2} + \frac{3.25}{(1+r)^3} + \frac{3.25}{(1+r)^4} + \frac{3.25}{(1+r)^5} + \frac{3.25}{(1+r)^6} + \frac{103.25}{(1+r)^7}$$

$$r = 2.695\%$$

The estimated yield for a six-year bond having the same credit quality is the average of two required yields:

Average yield = (2.858% + 2.695%)/2 = 2.777%

Given an estimated yield-to-maturity of 2.777%, the estimated price of the illiquid six-year, 3.5% annual coupon payment corporate bond is 103.95 per 100 of par value:

$$\text{Price} = \frac{3.50 \cdot (1 - v^6)}{r} + 100v^6$$

$$\text{Price} = \frac{3.50(1 - (1.02777)^{(-6)})}{0.02777} + 100(1.02777)^{(-6)} = 103.95$$

### Matrix Pricing Variation for New Bond Issues

Another variation for matrix pricing primarily focuses on spreads, specifically examining the differences between bond yields and benchmark bond yields. Often, default risk-free bonds, such as U.S. Treasury bonds, are used as benchmarks for U.S. dollar-denominated corporate bonds. To estimate the Yield-to-Maturity (YTM) for a new bond, one must identify the appropriate spread to the yield of a Treasury bond with similar maturity. By adding this spread to the yield of the benchmark issue, the YTM for the new bond can be accurately estimated.

## Example: Estimating the Yield for a New 8-Year, BBB-Rated Bond Issue

Consider the following market yields:

- 6-year, U.S. Treasury bond, YTM 1.95%



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- 6-year, BBB-rated corporate bond, YTM 3.25%
- 10-year, U.S. Treasury bond, YTM 2.70%
- 10-year, BBB-rated corporate bond, YTM 4.30%
- 8-year U.S. Treasury bond, YTM 2.30%

Estimate the required yield on a newly issued 8-year, BBB-rated corporate bond.

Calculate the spreads to the benchmark (Treasury) yields: Spread on the 6-year corporate bond is 3.25-1.95=1.30%. Spread on the 10-year corporate bond is 4.30-2.70=1.60%. Calculate the average spread because the 8 -year bond is the midpoint of six and ten years:

$$\text{Average spread} = \frac{(1.30 + 1.60)}{2} = 1.45$$

Add the average spread to the YTM of the 8-year Treasury (benchmark) bond: 2.30+1.45=3.75%, which is our estimate of the YTM on the newly issued 8year, BBB rated bond.

## Question 1

Consider the following market yields:

- 5-year, US. Treasury bond, YTM 2.10%
- 5-year, A-rated corporate bond, YTM 3.60%
- 9-year, US. Treasury bond, YTM 2.80%
- 9-year, A-rated corporate bond, YTM 4.60%
- 7-year US. Treasury bond, YTM 2.40%

Estimate the required year on a newly issued 7-year, A-rated corporate bond.

A. 1.65%
B. 4.05%



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C. 4.10%

## Solution

**The correct answer is B:**

Calculate the spreads to the benchmark (Treasury) yields:

Spread on the 5-year corporate bond is 3.60-2.10=1.50%.

Spread on the 9-year corporate bond is 4.60-2.80=1.80%

Calculate the average spread because the 7-year bond is the midpoint of five and nine years:

Average Spread $=\frac{(1.50+1.90)}{2}=1.65$

Add the average spread to the YTM of the 7-year Treasury (benchmark) bond:

2.40+1.65=4.05%, which is our estimate of the YTM on the newly issued 7-year.

## Question 2

In matrix pricing, what type of market data is typically observed for the identified similar securities?

A. Company's earnings reports

B. Price-to-earnings ratios

C. Prices, yields, and other relevant data

## Solution

**The correct answer is C.**

In matrix pricing, the market data observed for similar securities includes prices, yields, and other relevant data. This information provides the necessary inputs to interpolate or extrapolate the price or yield for the bond being valued. By analyzing the relationship between price and yield among similar bonds, matrix pricing can accurately estimate the value of a bond that may not have recent or regular trading activity.



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**A is incorrect.** Company's earnings reports are related to equity valuation and are not typically relevant to the valuation of fixed-income securities.

**B is incorrect.** Price-to-earnings ratios are used in equity analysis and not relevant to matrix pricing for bonds.

## Question 3

Which of the following best describes the reason for using matrix pricing in the valuation of portfolio securities?

A. To provide speculative price targets
B. To estimate the fair value of securities not actively traded
C. To analyze market trends for active trading

## Solution

**The correct answer is B.**

Matrix pricing is used to estimate the fair value of securities not actively traded, especially in the context of bonds. For securities that do not have a liquid market, it becomes difficult to determine a fair market price. Matrix pricing overcomes this challenge by utilizing data from similar, more liquid securities to derive an estimated value for the illiquid security. This approach is systematic and grounded in observable market data, making it a reliable method for valuing non-actively traded bonds.

**A is incorrect.** Speculative price targets are not the aim of matrix pricing. The method strives for an accurate and reasonable estimate of value based on observable data, not speculation.

**C is incorrect.** While market trends may be of interest in other contexts, matrix pricing is not a tool designed for active trading strategies or trend analysis.



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# Learning Module 7: Yield and Yield Spread Measures for Fixed Rate Bonds

## LOS 7a: calculate annual yield on a bond for varying compounding periods in a year

The yield on a bond is a measure of the return on investment, which depends on the interest rate and the frequency of compounding. Understanding how to calculate the annual yield for varying compounding periods is essential for investors to compare different investment options.

## Periodicity and Annualized Yields

The periodicity of the annual rate refers to the number of interest periods in a year. It is a crucial factor in the calculation of the effective yield on a bond. The periodicity typically aligns with the frequency of coupon payments:

- Annual: Periodicity = 1
- Semiannual: Periodicity = 2
- Quarterly: Periodicity = 4

## Calculating Future Value of Cash Flows

The future value (FV) of cash flows represents the total value of a series of payments at a future point in time. It is calculated using the formula:

$$FV = FV(\text{rate}, \text{nper}, \text{pmt}, \text{pv}, \text{type})$$

Where:

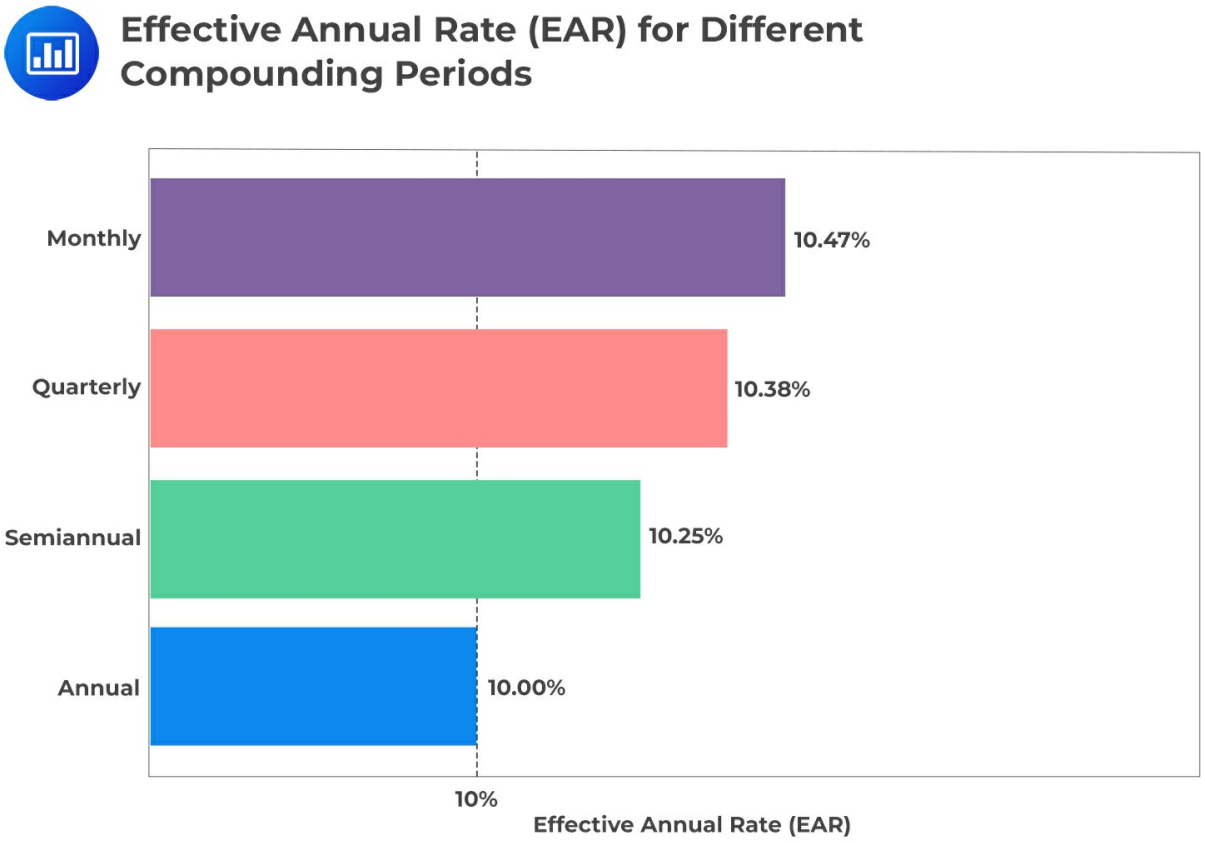
- rate is the periodic reinvestment rate
- nper is the number of periods in a year



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- pmt is the rate per period
- pv is the present value (optional)
- type indicates when payments occur (optional)

The following figure illustrates the Effective Annual Rate (EAR) for different compounding periods, emphasizing the subtle differences in yield:




Though the differences between the EAR values may appear small, they reveal how the frequency of compounding affects the effective yield on an investment. These variations can have a significant impact over time, especially with large investments or longer investment horizons.

Investors can gain insights into the importance of compounding frequency when evaluating different investment options. It allows for a nuanced understanding and comparison between bonds with



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different payment frequencies, considering the subtle but meaningful variations in yield that arise from changes in compounding periodicity.

**Periodicity Conversions**

A crucial instrument in the study of fixed-income assets involves transforming an annualized yield from one compounding frequency to another. Such transformations are known as periodicity or compounding adjustments. The following equation is used to convert an annual percentage rate for periods per year, denoted , to an annual percentage rate for periods per year, .

$$(1 + \frac{APR_m}{m})^m = (1 + \frac{APR_n}{n})^n$$

Where:

- $APR_m$ is the annual percentage rate for m periods per year
- $APR_n$ is the annual percentage rate for n periods per year
- m is the number of periods per year in the original periodicity
- n is the number of periods per year in the converted periodicity

## Example

An investor is considering a 3-year bond that pays a 6% annual coupon with a face value of $1,000. The bond is currently priced at $950. Calculate the effective annual rate of the bond at issuance assuming annual, semiannual, and quarterly compounding.

### Solution

**Parameters:**

- Face Value (F): $1,000
- Current Price (P): $950



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- Time to Maturity: 3 years
- Coupon Rate: 6%
- Coupon Payment: $60 (6% of $1,000)

## Calculate the yield for Different Compounding Periods

### Annual Compounding

$$950 = \frac{60}{(1+r)^1} + \frac{60}{(1+r)^2} + \frac{1000+60}{(1+r)^3}$$

r has been calculated using excel as 7.938%

Semi-annual compounding (n=2)

Convert from a periodicity of m = 1 to periodicities of n = 2 and n = 4

This converts the effective annual rate to semiannual and quarterly bond equivalent yield.

$$(1 + \frac{0.07938}{1})^1 = (1 + \frac{APR_2}{2})^2$$

$$\sqrt{(1.07938)} = 1 + \frac{APR_2}{2}$$

$$APR_2 = 7.786\%$$

$$(1 + \frac{0.07938}{1})^1 = (1 + \frac{APR_2}{2})^2$$



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Quarterly compounding (n=4)

$$(1 + \frac{0.07938}{1})^{1} = (1 + \frac{APR_4}{4})^{4}$$

$$APR_4 = 7.712\%$$

**Explanation**

Annual Compounding: The bond yield is highest when compounded annually. This is because there is less frequent reinvestment of the coupon payments, leading to a lower accumulation of interest.

Semiannual and Quarterly Compounding: As the frequency of compounding increases, the YTM decreases slightly. This is due to the more frequent reinvestment of coupon payments, which compounds more often and thereby increases the effective yield of the bond.

Thus, varying compounding frequencies can affect the bond's yield, usually leading to a decrease in YTM as the frequency increases.

## Question

A yield of 2.432% compounded quarterly is closest to an effective annual rate of:

A. 0.430%
B. 2.447%
C. 2.454%

# Solution

**The correct answer is C:**

The effective annual rate assumes a single compounding period in a year (periodicity of 1). To



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convert from quarterly to annual compounding, we need to change from a periodicity of 4 to 1:

$$(1 + \frac{APR_m}{m})^m = (1 + \frac{APR_n}{n})^n$$

$$(1 + \frac{0.02432}{4})^4 = (1 + \frac{APR_1}{1})^1$$

$$APR_1 = 2.454\%$$



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## LOS 7b: compare, calculate, and interpret yield and yield spread measures for fixed-rate bonds

# Yield Measures for Fixed-Rate Bonds

Understanding yield measures for fixed-rate bonds is essential for investors aiming to assess the potential return on a bond investment. The yield measures, including current yield, yield to maturity (YTM), yield to call (YTC), and yield to worst (YTW), offer different perspectives on the potential return, each taking into account various factors.

# Overview of Yield Conventions

### Actual/Actual

This convention counts the real number of days from the previous coupon payment to the settlement date and divides it by the actual number of days in a coupon period based on the actual number of days in a year. It is generally applied to government bonds.

### 30/360

It assumes 30 days in a month and 360 days in a year while calculating the number of days from the last coupon payment to the settlement date. It is most commonly used for corporate bonds.

### Street Convention

A yield calculation that does not take weekends and bank holidays into account, assuming that cash flows are received on scheduled dates.

### True Yield

True yield adjusts for weekends and bank holidays, assuming cash flows will be received after their scheduled dates. It is never greater than the street convention yield due to the time delay in



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payment.

## Government Equivalent Yield

This converts the Yield-to-Maturity from a 30/360 day count to an actual/actual day count. It is used to adjust the Yield-to-Maturity (YTM) of a corporate bond to determine its spread above the corresponding government bond YTM.

## Simple Yield

This is a yield metric calculated as the sum of coupon payments plus the straight-line amortized portion of any gain or loss, all divided by the flat price of the bond. It is mainly used to quote Japanese government bonds (JGBs).

## Current Yield

The **current yield** is a simple measure that represents the annual income (interest) as a proportion of the bond's current market price. This measure only focuses on interest income and ignores the time value of money, frequency of coupon payments, and accrued interest. It is calculated as:

$$\text{Current Yield} = \frac{\text{Annual Income}}{\text{Current Market Price}}$$

## Yield to maturity (YTM)

The **Yield to Maturity (YTM)** is a comprehensive measure, representing the total anticipated return if the bond is held to maturity. It takes into account both the current market price and the total amount of interest payments.

To solve for YTM using the bond pricing equation:

$$PV = \frac{PMT_1}{(1+r)^1} + \frac{PMT_2}{(1+r)^2} + \cdots + \frac{PMT_N + FV_N}{(1+r)^N}$$

Where:



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- $PV$ = Current market price
- $PMT$ = Periodic Coupon payments
- $r$ = Yield-to-maturity
- $FV$ = Face value of the bond
- $N$ = the remaining number of periods until maturity

### Yield Measures for Callable Bonds

Special consideration is required for fixed-rate bonds with embedded options, such as callable bonds. These bonds have features that allow the issuer to buy back the bond at specific prices on predetermined dates, requiring alternative yield measures.

### Yield to Call (YTC)

The Yield to Call (YTC) considers the possibility of the bond being called prior to maturity. This yield is valid only if the bond is called and is calculated as

$$PV = \frac{PMT}{(1+r)} + \frac{PMT}{(1+r)^2} + \ldots + \frac{PMT + \text{Call Price}}{(1+r)^N}$$

### Yield to Worst (YTW)

The Yield to Worst (YTW) is the most conservative measure, representing the minimum yield that can be received without the issuer defaulting. It is calculated by considering the worst-case scenario, including provisions like prepayments or callback, and is the minimum of YTM and YTC.

$$\text{Yield to Worst} = \text{Minimum}(\text{Yield to Maturity}, \text{Yield to Call}).$$

## Yield Spread Measures for Fixed-Rate Bonds

Yield spread measures are used to compare bonds by evaluating the differences between their yields. These measures are crucial for understanding the relative value and risks associated with different



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bonds.

### Absolute Yield Spread

This measure represents the difference in yield between two bonds, usually measured in basis points (bps), and is calculated as

$$\text{Absolute Yield Spread} = \text{Yield of Bond A} - \text{Yield of Bond B}.$$

### Relative Yield Spread

The relative yield spread normalizes the absolute yield spread by dividing it by the yield of the benchmark bond, expressing it as a percentage. It is calculated as:

$$\text{Relative Yield Spread} = \frac{\text{Absolute Yield Spread}}{\text{Yield of Benchmark Bond}}.$$

### Yield Ratio

The yield ratio provides a comparison between the yield of a bond and a benchmark bond, expressed as a ratio, and is calculated as

$$\text{Yield Ratio} = \frac{\text{Yield of Bond}}{\text{Yield of Benchmark Bond}}$$

.

## Example: Yield Measures for Fixed-Rate Bonds

Consider a 5-year, semiannual-pay 3% callable bond with a face value of $1,000. The bond can be called each year after 3 years at a call price of $1,050. An investor is considering purchasing the bond at a current market price of $980. Calculate the Current Yield, Yield to Maturity (YTM), Yield to Call (YTC), and Yield to Worst (YTW) for this bond. Additionally, if there is a similar non-callable bond in the market with a yield of 5.8%, calculate the Absolute Yield Spread, Relative Yield Spread, and Yield Ratio between the callable bond and the benchmark non-callable bond.



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**Solution**

- Face Value: $1,000
- Coupon Rate: 6%
- Current Market Price: $980
- Maturity: 5 years (10 periods)
- Callable after 3 years, with subsequent calls every year
- Yield of Benchmark Non-Callable Bond: 5.8%

## Current Yield:

Since the coupon rate is 6%, the annual coupon payment is calculated as:

$$\text{Annual Income} = 6\% \times \$1,000 = \$60.$$

The current yield is a measure that represents the annual income as a proportion of the bond's current market price. It can be calculated using the formula:

$$\text{Current Yield} = \frac{\text{Annual Income}}{\text{Current Market Price}}$$

.

By substituting the given values into the formula:

$$\text{Current Yield} = \frac{\$60}{\$980} \approx 6.12\%$$

.

## Yield to Maturity (YTM):

Since the coupon rate is 6%, the annual coupon payment is $60. The bond pays coupons semi-



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annually, so the semi-annual coupon payment is:

$$\text{Coupon Payment} = \frac{\$60}{2} = \$30.$$

The Yield to Maturity is the interest rate that equates the present value of the bond's future cash flows to its current market price. It can be found by solving the following equation:

$$PV = \frac{\text{Coupon Payment}}{(1+r)} + \frac{\text{Coupon Payment}}{(1+r)^2} + \ldots + \frac{\text{Coupon Payment} + \text{Face Value}}{(1+r)^{10}}$$

where r is the yield per period (YTM/2).

Yield to Maturity ≈ 6.475%.

The Yield to Maturity (YTM) for the given callable bond is approximately 6.475%, representing the total anticipated return if the bond is held to maturity.

## Yields to Call:

To calculate the yield-to-first call, we calculate the yield-to-maturity using the number of semiannual periods until the first call date of 10 and the call price of 1,050.

$$PV = \frac{\text{Coupon Payment}}{(1+r)} + \frac{\text{Coupon Payment}}{(1+r)^2} + \ldots + \frac{\text{Coupon Payment} + \text{Call Price}}{(1+r)^N}$$

where r is the yield per period (Yield to Call/2), and N is the number of periods to the call date.

Assuming that the bond can be called every year after the 3rd year, we will calculate the yield to the first, second, and third call. Yields to Calls:

Yield to First Call: 8.269%

Yield to Second Call: 7.682%

Yield to Third Call: 7.331%

For the given callable bond, the decreasing pattern in the yield to calls is observed due to the fixed



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call price of $1,050 and the semi-annual coupon payments. The yield to call accounts for both the call price and the remaining interest payments. As we move closer to maturity, the present value of the fixed call price becomes a larger proportion of the overall yield calculation, and the effect of the remaining interest payments diminishes. Since the call price is greater than the current market price but less than the face value, the yields to calls lie between the current yield and the YTM. This specific pattern leads to decreasing yields to calls, with the YTM being the lowest of all, reflecting the structure and pricing of the bond.

**Yield to Worst Call:**

The yield to worst call is the minimum yield among all the possible call dates, and the yield to maturity:

Yield to Worst Call = 6.475%.

The purpose of yield-to-worst is to provide to the investor with the most conservative assumption for the rate of return.

**Absolute Yield Spread:**

The Absolute Yield Spread is the difference in yield between the callable bond and the benchmark bond. It is calculated as:

$$\text{Absolute Yield Spread} = \text{Yield of Callable Bond} - \text{Yield of Benchmark Bond} = 6.475\% - 5.8\% = 0.675\%$$

**Relative Yield Spread:**

The Relative Yield Spread normalizes the absolute yield spread by dividing it by the yield of the benchmark bond. It is calculated as:

$$\text{Relative Yield Spread} = \frac{\text{Absolute Yield Spread}}{\text{Yield of Benchmark Bond}} = \frac{0.675\%}{5.8\%} \approx 11.64\%.$$

**Yield Ratio:**

The Yield Ratio provides a comparison between the yield of the callable bond and the benchmark bond, expressed as a ratio. It is calculated as:



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$$\text{Yield Ratio} = \frac{\text{Yield of Callable Bond}}{\text{Yield of Benchmark Bond}} \approx 1.116.$$

The Absolute Yield Spread, Relative Yield Spread, and Yield Ratio between the callable bond and the benchmark non-callable bond provide insights into the relative value and risks associated with the bonds.

### Yield Spreads over Benchmark Rates

Understanding yield spreads is crucial for bond investors. Yield spreads enable analysts to compare the current spread against historical averages and other bonds. This helps in identifying whether a bond is underpriced or overpriced relative to its risk.

## Types of Spreads

### G-Spread

This is the difference between the yield-to-maturity of a specific bond and a benchmark bond, often a government bond. It represents the return for bearing risks relative to the sovereign bond.

G-Spread = YTM of Bond - YTM of Benchmark Bond

### Z-Spread

This represents the constant yield spread over a benchmark yield curve that makes the present value of a bond's cash flows equal to its price. It is used to derive the term structure of credit spreads for an issuer.

$$PV = \frac{PMT}{(1+z1+Z)^1} + \frac{PMT}{(1+z2+Z)^2} + \cdots + \frac{PMT+FV}{(1+z_N+Z)^N}$$

$z_1, z_2, \ldots, z_N$ are the benchmark spot or zero rates obtained from the government yield curve or from fixed rates on interest rate swaps. On the other hand, $Z$ is the Z-spread per period and is the same for all time periods.

### Option-Adjusted Spread (OAS)



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This is the Z-spread adjusted for the value of any embedded options like call or put options. It is based on an option-pricing model and an assumption about future interest rate volatility.

$$OAS = Z - Spread - Option\ value\ in\ basis\ points\ per\ year$$

## I-Spread

This is the yield spread of a bond over the standard swap rate in the same currency and with the same tenor. Commonly used for euro-denominated corporate bonds.

## Example: Calculating G-spread, I-spread and Z-spread

An analyst is evaluating a 4-year, 3% annual coupon bond issued by XYZ Corp. Currently, the bond's yield-to-maturity (YTM) is 3.5%. The 4-year swap rate is 2.2%. The government spot rates are as follows:

| Maturity (Years) | Government Spot Rate (%) |
|---|---|
| | 1.0 |
| 2 | 1.4 |
| 3 | 2.0 |
| 4 | 2.5 |

The bond's current price is 97.50% of its par value.

The G-spread, I-spread, and Z-spread (in basis points) for the XYZ Corp bond are *closest to*:

**G-spread**

The G-spread is a yield spread above that of a government bond with the same maturity date. The yield-to-maturity for the corporate bond is 3.5%. The yield-to-maturity for the government benchmark bond is 2.5%.

G-spread =3.5%?2.5%=1%=100 bps.

**I-spread**

This is the yield spread of a bond over the standard swap rate in the same currency and with the



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same tenor. The yield-to-maturity for the corporate bond is 3.5%, and the swap rate for the same maturity is 2.2%.

I-spread = 3.5% – 2.2% = 1.30% = 130bps

**Z-spread**

To calculate the -spread, we must solve for  in the following equation, given the spot rates and price of the bond:

$$PV = \frac{PMT}{(1+z_1+Z)^1} + \frac{PMT}{(1+z_2+Z)^2} + \cdots + \frac{PMT+FV}{(1+z_N+Z)^N}$$

The Solver add-in for Microsoft Excel finds Z = 1.22, or 122bp, by setting the price (sum of present values of cash flows) equal to 97.50 as the objective and Z as the change variable.



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## Question

A 2-year sovereign non-callable bond is priced at 104.50 per 100. The bond pays a 1.5% semiannual coupon. The annual yield-to-maturity for the bond is closest to:

A. -0.365%

B. -0.730%

C. 1.435%

Solution

## The correct answer is B.

To find the yield-to-maturity, we can solve for $r$ in the equation for the present value of the bond's cash flows.

$$104.50 = \frac{0.75}{(1+r)^1} + \frac{0.75}{(1+r)^2} + \frac{0.75}{(1+r)^3} + \frac{100.75}{(1+r)^4}$$

$$r = -0.730\%$$



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# Learning Module 8: Yield and Yield Spread Measures for Floating Rate Instruments

## LOS 8a: calculate and interpret yield spread measures for floating-rate instruments.

## Floating Rate Instruments

Floating-rate instruments, such as floating-rate notes (FRNs) and most loans, differ from fixed-rate bonds in their periodic payment dynamics. Their interest payments fluctuate based on a reference interest rate, ensuring the borrower's base rate remains aligned with prevailing market conditions. For lenders or investors, this means minimized price risk amidst interest rate volatilities. For instance, an FRN issued by a company will adjust its interest payments depending on a prevalent market reference rate (MRR), such as LIBOR. This mechanism ensures that even amidst unstable interest rates, the FRN's price remains steady as its cash flows recalibrate with rate changes.

## Market Reference Rate (MRR)

The MRR on an FRN or loan is usually a short-term money market rate. The reference rate is determined at the beginning of the period, and the interest payment is made at the end of the period. This payment structure is called in arrears. For example, if the MRR is based on the 3-month LIBOR, the interest payment for a period will be determined by the LIBOR rate at the start of the period. The most common day-count conventions for calculating accrued interest on floaters are actual/360 and actual/365. To this MRR, a specified spread, called the quoted margin, is either added or subtracted.

## Quoted Margin

The quoted margin, a specified spread over or under the reference rate, compensates the investor for the differential in credit risk associated with the issuer relative to the implications of the



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reference rate. For example, consider Tesla. If it possesses a greater credit risk relative to a government treasury and issues an FRN, the associated quoted margin would surpass that of an FRN put forth by the government. This increased margin acts as a form of compensation, offsetting the increased risk that investors assume when opting for Tesla over a more secure government note.

## Required Margin

The required margin (discount margin) is the yield spread over or under the reference rate such that the FRN is priced at par value on a rate reset date. It is determined by the market. Changes in the required margin usually come from changes in the issuer’s credit risk. Changes in liquidity or tax status can also affect the required margin. For example, if the issuer's credit rating is downgraded, the required margin may increase as investors demand a higher return for the increased risk.

### Relationship between the Required Margin and Floater's Price at Reset Date

When the required margin is greater than the quoted margin, the floater tends to be priced at a discount. This phenomenon can often be traced back to changes in the issuer's credit risk. Specifically, at the reset date, if the required margin overshadows the quoted margin, it results in the floater making what is termed a "deficient" interest payment. This deficiency, in turn, leads to the floater being priced below its par value, solidifying its position at a discount.

Conversely, when the required margin is exactly equal to the quoted margin, the floater is said to be priced at par. The rationale behind this is that the alignment between the required and quoted margins naturally drives the floater's flat price towards its par value, especially as the next reset date comes into the horizon.

Lastly, in situations where the required margin is less than the quoted margin, the floater enjoys premium pricing. This is indicative of favorable market conditions for that particular floater.

## Valuation of Floating-Rate Note



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Valuing a floating-rate note (FRN) necessitates the use of a pricing model. For a fixed-rate bond, the price is determined based on a market discount rate, denoted as r, and a coupon payment per period, denoted as PMT. The formula to calculate this price is as follows:

$$PV = \frac{PMT}{(1+r)} + \frac{PMT}{(1+r)^2} + \ldots + \frac{PMT + FV}{(1+r)^N}$$

Where:

- PV = present value, or the price of the bond
- PMT = Coupon payment per period
- r = the market discount rate
- FV = the future value paid at maturity, or the par value of the bond
- N = the number of evenly spaced periods to maturity

In the context of an FRN, PMT is derived from the Market Reference Rate (MRR) and the quoted margin. r is influenced by the MRR and the margin. The price of an FRN is calculated using the formula:

For an FRN, the price is calculated using the following formula:

$$PV = \frac{\frac{(MRR+QM)\times FV)}{m}}{(1+\frac{MRR+DM}{m})} + \frac{\frac{(MRR+QM)\times FV)}{m}}{(1+\frac{MRR+DM}{m})^2} + \ldots + \frac{\frac{(MRR+QM)\times FV)}{m} + FV}{(1+\frac{MRR+DM}{m})^N}$$

Where:

- PV = present value, or the price of the floating-rate note
- MRR = the market reference rate, stated as an annual percentage rate
- QM = the quoted margin, stated as an annual percentage rate
- FV = the future value paid at maturity, or the par value of the bond



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- m = the periodicity of the floating-rate note, the number of payment periods per year
- DM = the discount margin = required margin stated as an annual percentage rate
- N = the number of evenly spaced periods to maturity

## Example: Calculating the Price of a Floating-Rate Note

Suppose we are pricing a three-year, semi-annual FRN that pays MRR plus 0.75%. Assume MRR is 1.50% and the yield spread required by investors is 50bps. Given:

- MRR = 0.0150
- QM = 0.0075
- FV = 100
- m = 2
- DM = 0.0050
- N = 6

Calculate the price of the floating rate instrument.

**Solution**

Determine the coupon payment for each period:

$$PMT = \frac{MRR + QM}{m} \times FV$$

$$PMT = \frac{0.0150 + 0.0075}{2} \times 100$$

$$PMT = \frac{0.0225}{2} \times 100$$

$$PMT = 1.125$$

Calculate the present value of each cash flow: For i = 1 to N :



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$$PV_i = \frac{PMT}{(1 + \frac{(MRR+DM)}{m})^i}$$

E.g., for i=1

$$PV_1 = \frac{1.125}{(1 + \frac{0.0150+0.0050}{2})^1} = 1.1139$$

Finally, the price of the FRN is the sum of all present values plus the present value of the face value at maturity:

$$\sim Price \sim = \sum_{i=1}^{N} PV_i + \frac{FV}{(1 + \frac{MRR+DM}{m})^N}$$

The price of the FRN has been calculated as: 100.724



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## Question

A floating-rate note has a quoted margin of +60bps and a required margin of +85bps. On its next reset date, the note is said to be priced at:

A. par
B. A discount
C. A premium

**Solution**

The correct answer is **B.**

When the required margin is greater than the quoted margin, the floater tends to be priced at a discount. This phenomenon can often be traced back to changes in the issuer's credit risk. Specifically, at the reset date, if the required margin is greater than the quoted margin, it results in the floater making what is termed a "deficient" interest payment. This deficiency, in turn, leads to the floater being priced below its par value, solidifying its position at a discount.

**A is incorrect:** When the required margin is exactly equal to the quoted margin, the floater is said to be priced at par. The rationale behind this is that the alignment between the required and quoted margins naturally drives the floater's flat price towards its par value, especially as the next reset date comes into the horizon.

**C is incorrect:**

When the required margin is less than the quoted margin, the floater is said to be priced at a premium. This is indicative of favorable market conditions for that particular floater.



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## LOS 8b: calculate and interpret yield measures for money market instruments.

Money market instruments are short-term debt securities with original maturities of one year or less. They are a crucial part of the financial market and include a variety of instruments such as overnight sale and repurchase agreements (repos), bank certificates of deposit, commercial paper, Treasury bills, bankers' acceptances, and time deposits based on market reference rates. For instance, a company might issue commercial paper to meet its short-term liquidity needs. Money market mutual funds, which invest solely in eligible money market securities, are sometimes considered as an alternative to bank deposits.

Yield measures for money market instruments differ from those for bonds in several ways. Firstly, bond yields-to-maturity are annualized and compounded, while yield measures in the money market are annualized but not compounded. This means the return on a money market instrument is stated on a simple interest basis. For example, if you invest $1000 in a 90-day Treasury bill with a yield of 1%, you would earn $10 at the end of the period.

Secondly, bond yields-to-maturity are usually stated for a common periodicity for all times-to-maturity, while money market instruments with different times-to-maturity have different periodicities for the annual rate. Lastly, bond yields-to-maturity can be calculated using standard time-value-of-money analysis, while money market instruments are often quoted using non-standard interest rates and require different pricing equations than those used for bonds.

Quoted money market rates are either discount rates or add-on rates. Commercial paper, Treasury bills, and bankers' acceptances are often quoted on a discount rate basis, while bank certificates of deposit, repos, and market reference rate indexes are quoted on an add-on rate basis. In the money market, the discount rate involves an instrument for which interest is included in the face value of the instrument, while an add-on rate involves interest that is added to the principal or investment amount.

The pricing formula for money market instruments quoted on a discount rate basis is:

$$PV = FV \times \left(1 - \frac{\text{Days}}{\text{Year}} \times DR\right)$$



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Where:

PV = present value, or the price of the money market instrument

FV = the future value paid at maturity, or the face value of the money market instrument

Days = the number of days between settlement and maturity

Year = the number of days in the year

DR = the discount rate, stated as an annual percentage rate

$$DR = \frac{Year}{Days} \times \frac{(FV - PV)}{FV}$$

The pricing formula for money market instruments quoted on an add-on rate basis is:

$$PV = \frac{FV}{1 + \frac{Days}{Year} \times AOR}$$

Where:

PV = present value, the principal amount, or the price of the money market instrument

FV = the future value, or the redemption amount paid at maturity, including interest

Days = the number of days between settlement and maturity

Year = the number of days in the year

AOR = the add-on rate, stated as an annual percentage rate

$$AOR = \frac{Year}{Days} \times \frac{FV - PV}{PV}$$

Investment analysis is more challenging for money market securities because some instruments are quoted on a discount rate basis while others are on an add-on rate basis, and some assume a 360-day year, and others use a 365-day year. Furthermore, the “amount” of a money market instrument quoted by traders on a discount rate basis typically is the face value paid at maturity, while the



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“amount” when quoted on an add-on rate basis usually is the price at issuance.

## Comparing Money Market Instruments on Bond Equivalent Yield Basis

The bond equivalent yield, often termed the investment yield, quantifies a money market rate using a 365-day add-on rate method.

Step 1:

For money market assets priced with a Discount Rate (DR), compute the Price for every 100 of Par (PV) as:

$$PV = FV \times (1 - \frac{Days}{Year} \times DR)$$

Step 2:

From the PV obtained in Step 1, determine the Add-on Rate (AOR) for that specific money market asset:

$$AOR = \frac{Year}{Days} \times (\frac{FV - PV}{PV})$$

Step 3:

The Bond Equivalent Yield (BEY) represents a money market rate defined using a 365-day AOR method.

With this, the asset can be evaluated alongside other money market assets that use the Bond Equivalent Yield as their standard.

### Example: Determining the Bond Equivalent Yield

Suppose an investor is comparing the following two money market instruments:



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A. A 60-day Treasury bill issued by the government, quoted at a discount rate of 0.050% for a 360-day year.
B. A 60-day bank certificate of deposit, quoted at an add-on rate of 0.060% for a 365-day year.

Which one offers the higher expected rate of return, assuming the same credit risk?

**Solution**

60-day Treasury bill:

- Days = 60
- Year = 360
- DR (Discount Rate )= 0.050% or 0.0005

Using the formula:

$$PV = FV \times (1 - \frac{Days}{Year} \times DR)$$

$$PV = 100 \times (1 - \frac{60}{360} \times 0.0005) = 99.99$$

$$AOR = \frac{Year}{Days} \times (\frac{FV - PV}{PV})$$

$$AOR = \frac{365}{60} \times (\frac{100 - 99.99}{99.99}) = 0.0608\%$$

The bond equivalent rate is, therefore, 0.0608%

The bond equivalent rate for the 60-day bank certificate of deposit is 0.060% or 0.0006.

The 60-day Treasury bill offers a higher annual return relative to the 60-day bank certificate of deposit.



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## Question

The bond equivalent yield of a 180-day Treasury bill quoted at a discount rate of 0.75% for a 360 -day year is closest to:

A. 0.750%

B. 0.753%

C. 0.763%

**Solution**

The correct answer is **C.**

Step 1:

For money market assets priced with a Discount Rate (DR), compute the Price for every 100 of Par (PV) as:

$$PV = FV \times (1 - \frac{\text{Days}}{\text{Year}} \times DR)$$

$$PV = 100 \times (1 - \frac{180}{360} \times 0.75\%) = 99.6250$$

Step 2:

From the PV obtained in Step 1, determine the Add-on Rate (AOR) for that specific money market asset:

$$AOR = \frac{\text{Year}}{\text{Days}} \times (\frac{FV - PV}{PV})$$

$$AOR = \frac{365}{180} \times (\frac{100 - 99.6250}{99.6250}) = 0.763\%$$



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# Learning Module 9: The Term Structure of Interest Rates: Spot, Par and Forward Curves

## LOS 9a: define spot rates and the spot curve, and calculate the price of a bond using spot rates.

## Spot Rates

Spot rates are the market discount rates for default-risk-free zero-coupon bonds. Unlike typical bonds that offer periodic interest payments, these bonds are sold at a discount and repaid at face value upon maturity. Sometimes referred to as "zero rates," using a sequence of spot rates ensures a bond price that prevents arbitrage opportunities. In finance, this no-arbitrage condition ensures consistent asset pricing across markets, eliminating the chance for investors to gain risk-free profit from price differentials.

## Spot Curve

The spot curve visually charts the yield-to-maturity of default-risk-free zero-coupon bonds against their maturities. Often termed the "zero" or “strip” curve, the "strip" terminology originates from the stripping of periodic coupon payments, converting bonds to zero-coupon status. An example of this is the spot curve of Canadian Government bonds shown below:

### Types of Spot Curves

- Upward sloping spot curve: this is observed when longer-term government bonds yield higher than shorter-term bonds. It is a typical pattern under normal market conditions.
- Downward sloping (inverted) yield curve: this rarer configuration, where shorter-term yields are higher than longer-term yields, can signal impending economic downturns. It suggests that investors anticipate lower future rates, often due to expected economic slowdowns, and are thus more inclined to accept lower yields for longer-term bonds.

The spot curve is pivotal for maturity structure analysis, especially with government bonds that



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standardize elements like currency, credit risk, liquidity, and tax status. Notably, the absence of coupon reinvestment risk in zero-coupon bonds simplifies their evaluation.

## Calculating the Price of a Bond Using Spot Rates

To determine bond prices using the spot curve, each cash flow date corresponds to a specific discount rate. The goal is to achieve "no-arbitrage" prices. The bond's price is determined by discounting its cash flows with the corresponding spot rates. For bonds with periodic payments and a final principal repayment, the price is:

$$PV = \frac{PMT}{(1+Z_1)^1} + \frac{PMT}{(1+Z_2)^2} + \ldots + \frac{PMT + FV}{(1+Z_N)^N}$$

Where:

- $PV$ is the present value or price of the bond.
- $PMT$ is the periodic payment or coupon.
- $FV$ is the bond's face value.
- $Z_1, Z_2, \ldots Z_N$ are the spot rates for periods $1, 2, \ldots N$ respectively.

This approach ensures that the bond price remains consistent, whether discounted using spot rates or yield-to-maturity.

### Example: Calculating the Price of a Bond Using Spot Rates

Given the term structure of government bonds:

| Maturity | Yield-to-maturity |
|---|---|
| $1-Year$ | 1.5000% |
| $2-Year$ | 1.2500% |
| $3-Year$ | 1.0000% |
| $4-Year$ | 0.7500% |
| $5-Year$ | 0.5000% |



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Calculate the price of a 1.00% coupon, four-year government bond.

Formula:

$$PV = \frac{PMT}{(1+Z_1)^1} + \frac{PMT}{(1+Z_2)^2} + \ldots + \frac{PMT + FV}{(1+Z_N)^N}$$

$$PMT = 1\% \times 100 = 1$$

$$PV = \frac{1}{(1+0.015)^1} + \frac{1}{(1+0.0125)^2} + \frac{1}{(1+0.01)^3} + \frac{1+100}{(1+0.0075)^4} = 100.957$$



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## Question

Which of the following best describes a spot rate?

A. The yield-to-maturity of a coupon-bearing bond.
B. The market discount rate is applied to default-risk-free zero-coupon bonds.
C. The annual interest rate of a bond with periodic payments.

**Solution**

The correct answer is **B.**

Spot rates are market discount rates applied to default-risk-free zero-coupon bonds.

**A is incorrect:** The yield-to-maturity usually applies to coupon-bearing bonds, not specifically zero-coupon bonds.

**C is incorrect:** Spot rates are particularly associated with zero-coupon bonds and not bonds with periodic payments.



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## LOS 9b: define par and forward rates, and calculate par rates, forward rates from spot rates, spot rates from forward rates, and the price of a bond using forward rates.

# Par Rates

A par rate is the yield-to-maturity that equates the present value of a bond's cash flows to its par value (typically 100% of face value). Spot rates play a pivotal role in determining par rates. For a bond to be priced at par, its coupon rate and yield-to-maturity must be identical. This is depicted in the equation:

$$100 = \frac{PMT}{(1 + z_1)^1} + \frac{PMT}{(1 + z_2)^2} + \ldots + \frac{PMT + 100}{(1 + z_N)^N}$$

Here, $PMT$ represents the periodic payment, and $z_1, z_2, \ldots, z_N$ are the sequence of spot rates for respective periods. By solving for $PMT$, we obtain the yield-to-maturity that would make the bond trade at par, which is the par rate.

## Example: Calculating Par Rate Given Spot Rates

Given the following spot rates for government bonds. Note that these are effective annual rates:

| Term | Spot Rate |
|---|---|
| $1-Year$ | 4.50% |
| $2-Year$ | 4.90% |
| $3-Year$ | 5.25% |

**One-Year Par Rate**

Given the spot rate for one year is 4.50%, the one-year par rate will also be 4.50%.

$$100 = \frac{PMT + 100}{(1.0450)^1}$$

**Two-Year Par Rate:**



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Using the spot rates for one year and two years, we can derive the two-year par rate:

$$100 = \frac{PMT}{(1.0450)^1} + \frac{PMT + 100}{(1.0490)^2}$$

PMT has been calculated as 4.8904, which translates to a two-year par rate of 4.8904%.

**Three-Year Par Rate**

Using the spot rates for one, two, and three years:

$$100 = \frac{PMT}{(1.0450)^1} + \frac{PMT}{(1.0490)^2} + \frac{PMT + 100}{(1.0525)^3}$$

PMT has been calculated as 5.2252, which translates to a two-year par rate of 5.2252%.

## Forward Rates

Forward rates, often termed implied forward rates or forward yields, act as breakeven reinvestment rates. They establish a connection between the return on an investment in a shorter-term zero-coupon bond to the return on a longer-term zero-coupon bond. The most common market practice is to name forward rates by, for instance, "2y5y", which means "2-year into 5-year rate". The first number refers to the length of the forward period from today, while the second number refers to the tenor or time-to-maturity of the underlying bond.

Forward rates can be derived from spot rates and vice versa. The general formula to compute an implied forward rate between two periods is:

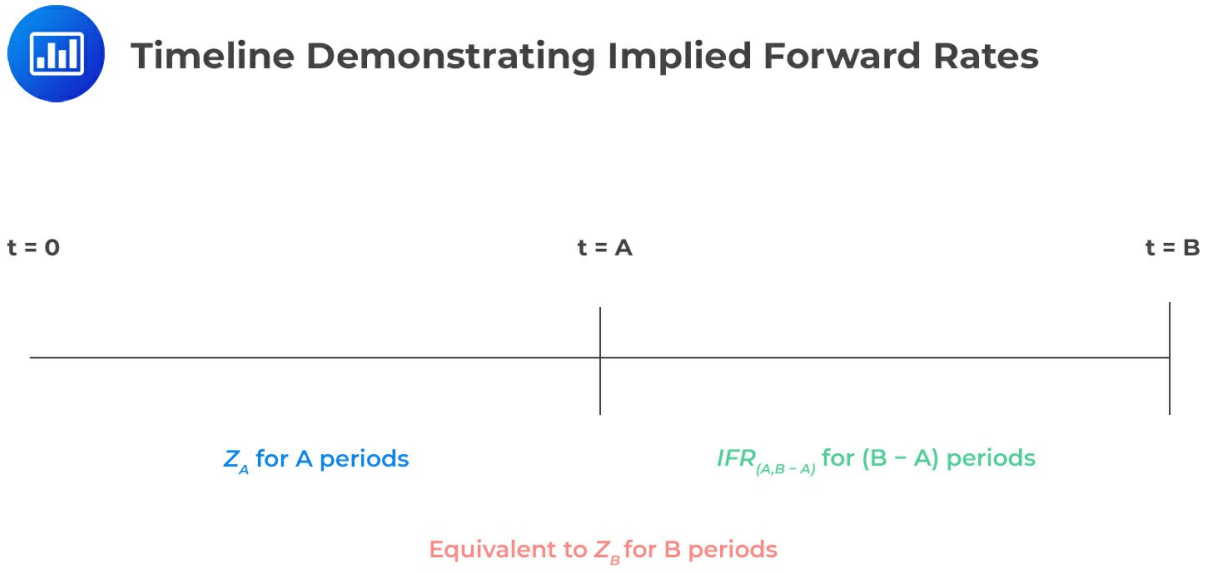
$$(1 + Z_A)^A \times (1 + IFR_{(A,B-A)})^{(B-A)} = (1 + Z_B)^B$$

Here, $IFR_{(A,B-A)}$ denotes the implied forward rate for a bond beginning at time $t = A$ and maturing at $t=B$. $Z_A$ and $Z_B$ represent spot rates for periods A and B, respectively.

The following figure demonstrates the implied forward rates:



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- The blue segment (from $t = 0$ to $t = A$) represents investing at the spot rate $Z_A$ for A periods.
- The green segment (from $t = A$ to $t = B$) represents investing at the implied forward rate $IFR_{(A,B-A)}$ for $B - A$ periods.
- The red segment at the bottom (spanning the entire timeline) signifies that the compounded return of the above two rates is equivalent to investing at the spot rate $Z_B$ for the entire B periods.

Forward rates are pivotal for investors and analysts as they provide insights into market expectations of future interest rate movements. They serve as breakeven rates, implying that if an investor's expectations align with the forward rate, they would be indifferent between investing in a longer-term bond now or investing in shorter-term bonds successively.

## Example: Calculating Implied Forward Rates from Spot Rates

Suppose that the yields-to-maturity on five-year and seven-year zero-coupon bonds are 4.85% and 5.45%, respectively, stated on a quarterly bond basis. An analyst wants to know the "5y2y" implied



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forward rate, which is the implied two-year forward yield five years into the future.

Given:

- $A = 20$ (periods, since 5 years $\times 4$ quarters per year)
- $B = 28$ (periods, since 7 years $\times 4$ quarters per year)
- $B - A = 8$ (periods)
- $z_{20} = \frac{0.0485}{4}$ (per period)
- $z_{28} = \frac{0.0545}{4}$ (per period)

Let's solve for $IFR_{20,8}$ (the implied forward rate from period 20 to period 28).

Formula:

$$(1 + z_{20})^{20} \times (1 + IFR_{20,8})^{8} = (1 + z_{28})^{28}$$

$$(1 + \frac{0.0485}{4})^{20} \times (1 + IFR_{20,8})^{8} = (1 + \frac{0.0545}{4})^{28}$$

$$(1 + \frac{0.0485}{4})^{20} \times (1 + IFR_{20,8})^{8} = (1 + \frac{0.0545}{4})^{28}$$

$$IFR_{20,8} = 1.738\%$$

The "5y2y" implied forward rate is approximately 1.738% on a quarterly basis. Annualized, the "5y2y" implied forward yield is 6.952%.

## Calculating Spot Rates from Forward Rates

Suppose the current forward curve for one-year rates is as follows:



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| Time Period | Forward Rate |
|---|---|
| 0y1y | 1.50% |
| 1y1y | 2.20% |
| 2y1y | 2.80% |

The provided rates are expressed on an annual basis with a period of one year, making them effective yearly rates. The initial rate, termed "0y1y," represents the spot rate for one year. The subsequent rates are forward rates for one-year durations. Using these rates, the spot curve can be determined by taking the geometric average of the forward rates. The two-year implied spot rate can be calculated as:

$$(1.0150 \times 1.0220) = (1 + z_2)^2$$

where $z_2$ is the two-year implied spot rate.

$$z_2 = 1.84940\%$$

Using this, and the 2y1y forward rate, we can then determine the three-year implied spot rate:

$$(1.0150 \times 1.0220 \times 1.0280) = (1 + z_3)^3$$

where $z_3$ is the three-year implied spot rate.

$$z_3 = 2.16529\%$$

Suppose an analyst needs to value a three-year, 2.50% annual coupon payment bond that has the same risks as the bonds used to obtain the forward curve. Using the implied spot rates, we can determine the value of the bond.

$$PV = \frac{PMT}{(1 + z_1)^1} + \frac{PMT}{(1 + z_2)^2} + \ldots + \frac{PMT + 100}{(1 + z_N)^N}$$

$$PV = \frac{2.5}{(1.0150)^1} + \frac{2.5}{(1.084940)^2} + \frac{2.5 + 100}{(1.0216529)^3}$$

$$PV = 100.993$$



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This bond can also be valued using the forward rates and generate the same result.

## Bond Pricing Using Forward Rates

Bonds can also be valued using forward rates. The bond's future cash flows are discounted at the product of the sequence of one-year forward rates leading up to each cash flow. The summation of these discounted cash flows gives the bond's price. The bond price remains consistent regardless of whether spot or forward rates are used.

### Example: Bond Pricing Using Forward Rates

Suppose the current forward curve for one-year rates is as follows:

| Time Period | Forward Rate |
|---|---|
| 0y1y | 1.50% |
| 1y1y | 2.20% |
| 2y1y | 2.80% |

Suppose an analyst needs to value a three-year, 2.50% annual coupon payment bond that has the same risks as the bonds used to obtain the forward curve. Determine the value of the bond using the forward rates above.

$$PV = \frac{2.5}{(1.0150)^1} + \frac{2.5}{(1.0150 \times 1.0220)} + \frac{2.5 + 100}{(1.0150 \times 1.0220 \times 1.0280)}$$

$$PV = 100.993$$



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## Question

Given a three-year spot rate of 3.5% and a four-year spot rate of 4%, what is the one-year forward rate three years from now (3yly)?

A. 2.720%

B. 3.75%

C. 5.515%

Solution

The correct answer is **C.**

Using the formula:

$$(1+Z_A)^A \times (1+IFR_{A,B-A})^{B-A} = (1+Z_B)^B$$

Where $A=3, B=4, Z_3=3.5\%$, and $Z_4=4\%$

$$(1+0.035)^3 \times (1+IFR_{3,1})^1 = (1+0.04)^4$$

Solving for $IFR_{3,1}$ will give 5.515%



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## LOS 9c: compare the spot curve, par curve, and forward curve.

Yields-to-maturity for zero-coupon government bonds could be analyzed for a full range of maturities called the government bond spot curve (or zero curves). Government spot rates are assumed to be risk-free.

### Spot Curve

The spot curve is upward-sloping and flattens for longer times-to-maturity. As a result, longer-term government bonds usually have higher yields than shorter-term bonds. The hypothetical spot curve is ideal for analyzing the maturity structure because it meets the "all other things being equal" assumption. The spot curve can also be inverted. This implies that one-year rates are expected to be lower in the future.

### Par Curve

The par curve is different from the spot curve because it is a sequence of yields-to-maturity, and each bond is priced at a par value. The par curve is obtained from the spot curve. All bonds on the par curve are supposed to have the same credit risk, periodicity, currency, liquidity, tax status, and annual yields. Between coupon payment dates, the flat price (not full price) is equal to the par value.

### Forward Curve

The forward curve is a series of forward rates, each of which has the same time frame.

The following diagram demonstrates a comparison of the Spot curve, Par Curve, and Forward Curve for the Canadian Government Bonds.

We can deduce the following from the figure above:

1. The spot rates exhibit a positive trend, leading to an upward-sloping spot curve.
2. The spot and par curves closely align; however, par rates are a bit lower than spot rates. This difference becomes more pronounced for longer maturities.
3. Forward rates are greater than both spot and par rates.



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These insights are rooted in the inherent relationships between curve patterns. When the spot curve trends upwards, par rates tend to be close to, but slightly beneath, spot rates, especially towards the long end of the curve. This is attributed to the influence of lower short-term spot rates, which increase the bond prices, especially for bonds with longer-term maturities. This increase, in turn, results in reduced par rates when calculations are based on a price equivalent to 100% of the par value.

The following table summarizes the relationship between spot, par, and forward curves.

| Spot Curve Shape | Par Curve | Forward Curve |
|---|---|---|
| Upward Sloping | Below spot curve | Above spot curve |
| Flat | Equal to spot curve | Equal to spot curve |
| Downward Sloping (Inverted) | Above spot curve | Below spot curve |



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## Question

When the spot curve is upward-sloping, how do the par rates typically compare to the spot rates?

A. Par rates are above spot rates.
B. Par rates are equal to spot rates.
C. Par rates are below spot rates.

**Solution**

**The correct answer is C:**

When the spot curve is upward-sloping, par rates tend to be close to, but slightly beneath, spot rates.

**A is incorrect:** Par rates are not typically above spot rates when the spot curve is upward-slopin.

**B is incorrect:** Par rates are not typically equal to spot rates; they are slightly below.



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# Learning Module 10: Interest Rate Risk and Return

## LOS 10a: calculate and interpret the sources of return from investing in a fixed-rate bond.

## Sources of Return

Investors in fixed-rate bonds achieve returns through the following:

- Receipt of anticipated coupon and principal payments.
- Reinvestment of coupon payments.
- Capital gains or losses are realized when the bond is sold prior to its maturity.

Discount bonds feature a coupon rate below the current market rate, while premium bonds have a coupon rate above the market rate. Over time, the book value of a bond is amortized to match its face value upon reaching maturity. The carrying value represents the bond's purchase price, adjusted for any amortized discount or premium. Rising interest rates decrease bond prices (and vice versa). This affects the total return, specifically if the bond is sold before maturity.

### Yield to Maturity (YTM)

This is an important metric for bond investors. When an investor holds a bond until its maturity, ensures no default on the bond, and consistently reinvests coupons at the same prevailing interest rate, the YTM then mirrors the investor's actual rate of return.

### Investment Horizon and Interest Rate Risk

The investment horizon is critical in assessing interest rate risks and returns. The interest rate risk comprises of two offsetting risks:

- Coupon reinvestment risk; and
- Market price risk.



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## Reinvestment Risk

Reinvestment risk pertains to the possibility that an investor may not be able to reinvest the cash flows from an investment at a rate matching the investment's existing rate of return (yield to maturity). Two factors affect the degree of reinvestment risk:

- **Maturity**: the longer the bond's maturity, the higher the reinvestment risk. This is because of the high possibility that interest rates will be lower than they were at the time the bond was purchased;
- **Coupon rate of the bond**: the higher the coupon rate, the higher the payments that have to be reinvested and, consequently, the higher the reinvestment risk. In fact, a bond selling at a premium is more dependent on reinvestment income than another bond selling at par. The only fixed-income instruments that do not have reinvestment risk are zero-coupon bonds since they have no interim coupon payments.

## Market Risk (Price Risk)

Bond market prices will decrease in value when the prevailing interest rates rise. In other words, if an investor wishes to sell the bond prior to maturity, the sale price will be lower if rates are higher.

As noted earlier, these two risks offset each other to an extent. The dominant risk depends partially on the investment horizon. The lower the investment horizon, the lower the reinvestment risk, but the higher the market risk.

## Horizon Yield (Realized Rate of Return)

This metric delves deeper, offering insight into an investor's internal rate of return (IRR). It considers the total return, which is composed of reinvested coupons and sale/redemption amount, divided by the purchase price of the bond.

$$r = \left(\frac{\text{FV} + \text{Sale/Redemption Amount}}{\text{PV}}\right)^{\frac{1}{T}} - 1$$



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Where:

- $FV$ = Future value of reinvested coupons
- $PV$ = Purchase price of the bond
- $T$ = Holding period

## Example: Sources of Return

An investor initially buys a 5-year, 8% annual coupon payment bond at the price of 85.00 per 100 of par value.

**Case 1: Holding the Bond Until Maturity**

The yield to maturity of the bond is calculated as follows.

$$85 = \frac{8}{(1+r)^1} + \frac{8}{(1+r)^2} + \frac{8}{(1+r)^3} + \frac{8}{(1+r)^4} + \frac{108}{(1+r)^5};\ r = 12.18$$

The bond's yield-to-maturity is 12.18%. The easiest way to determine the value of r is to use the financial calculator:

$$n = 5; PV = -85; PMT = 8; FV = 100; CPT => I/Y = 12.18$$

So the investor receives the series of 5 coupon payments of 8 (per 100 of par value), a total of 40, plus the redemption of principal (100) at maturity. Besides collecting the coupon interest and the principal, there is an opportunity to reinvest the cash flows. If the coupon payments are reinvested at 12.18% immediately after they are received, the coupon's future value on maturity date will amount to 51 per 100 par value, calculated as per the following table.

| End of Year 1 | End of Year 2 | End of Year 3 | End of Year 4 | End of Year 5 |
|---|---|---|---|---|
| $\$8 \times (1.1218)^4$ | $\$8 \times (1.1218)^3$ | $\$8 \times (1.1218)^2$ | $\$8 \times (1.1218)^1$ | $\$8 \times (1.1218)^0$ |

The $1^{st}$~ coupon payment of $8 is reinvested at 12.18% for 4 years until the end of the $5^{th}$~ year, the $2^{nd}$~ is invested for 3 years, and so forth. The amount in excess of the coupons, 11 (= 51 – (5 × 8)),



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is called "interest-on-interest" gain from compounding.

The investor's total return is 151, the sum of reinvested coupons (51), and the redemption of principal at maturity (100). Therefore, the realized rate of return is 12.18%.

$$85 = \frac{151}{(1 + r)^5};\ r = 12.18\%$$

As case 1 demonstrates, the yield-to-maturity at the time of purchase equals the investor's rate of return under the following three assumptions:

- the investor holds the bond to maturity;
- there is no default by the issuer; and
- the coupon interest payments are reinvested at that same rate of interest.

**Case 2: Selling the Bond Before Maturity**

If another investor buys the same bond but chooses to sell it after four years and reinvests all coupon payments at 12.18%, the future value of these reinvested coupons will be 38.3356% of the bond's face value at the end of the fourth year. This is calculated as follows:

| End of Year 1 | End of Year 2 | End of Year 3 | End of Year 4 |
|---|---|---|---|
| $\$8 \times (1.1218)^4$ | $\$8 \times (1.1218)^3$ | $\$8 \times (1.1218)^2$ | $\$8 \times (1.1218)^1$ |

Total = $38.3356

The interest-on-interest gain from compounding is $6.3356 (= 38.3356 - 32)$.

At the time the bond is sold, it has one year remaining until maturity. If the yield-to-maturity remains 12.18%, the sale price of the bond (calculated as the PV of anticipated cash flows) is:

$$\text{Price}_{t=4} = \frac{108}{1.1218} = 96.2738$$

Therefore, the total return is $134.6094 (= 38.3356 + 96.2738)$, and the realized rate of return is 12.18%.



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$$85 = \frac{134.6094}{(1+r)^4};\ r = 12.18\%$$

Case 2 demonstrates that the realized horizon yield matches the original yield-to-maturity provided two conditions are met:

- Coupon payments are reinvested at the same interest rate as the original yield-to-maturity; and
- The bond is sold at a price on the constant-yield price trajectory, i.e., the investor does not have any capital gains or losses when the bond is sold. The price trajectory is the time series of a bond's prices from some date (usually the date on which the bond is purchased) until its maturity.



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## Question

For a fixed-rate bond, what will most likely happen to its market price if interest rates rise?

A. The market price will rise.
B. The market price will remain unchanged.
C. The market price will fall.

**Solution**

**The correct answer is C:** Bond prices and interest rates have an inverse relationship. Thus, when interest rates increase, bond prices tend to fall.

**A is incorrect:** As mentioned, bond prices and interest rates have an inverse relationship. So, the market price won't rise with rising interest rates.

**B is incorrect:** Bond prices are sensitive to changes in interest rates, so they will not remain unchanged.



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**LOS 10b: describe the relationships among a bond’s holding period return, its Macaulay duration, and the investment horizon.**

## Holding Period Return (Horizon Yield)

This represents the total return an investor anticipates from holding a bond over a specific duration. It's influenced by both the coupon payments received and any change in the bond's price due to interest rate movements.

Formula:

$$r = \left(\frac{FV + F}{PV}\right)^{\frac{1}{T}} - 1$$

Where:

- $r$ = Realized rate of return or Horizon Yield.
- $FV$ = Future value of the reinvested coupons.
- $F$ = Face value of the bond (often considered as 100).
- $PV$ = Present value or the bond's current price.
- $T$ = Investment horizon.

An example of calculating the horizon yield was provided in the previous learning objective.

## Macaulay Duration

Introduced by Frederick Macaulay in 1938, the Macaulay duration provides a measure of the weighted average time until a bond's cash flows are received. It serves as an indicator of the bond's price sensitivity to interest rate changes. When the investment horizon matches the Macaulay duration of a bond, the bond is nearly hedged against interest rate risk. Any loss from price risk due to rising rates is approximately offset by gains from reinvestment risk and vice versa. We will delve



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deeper on the Macaulay Duration on the next learning objective.

## Investment Horizon

This is the period an investor plans to hold onto a bond. The relationship between the investment horizon and the Macaulay duration determines the bond's dominant source of interest rate risk:

- **Investment Horizon > Macaulay Duration**: The bond faces a dominant risk from reinvestment, arising due to the reinvestment of coupons, possibly at a less favorable rate.
- **Investment Horizon < Macaulay Duration**: Price risk is the prevailing concern. The bond's price might be adversely affected by rising interest rates.
- **Investment Horizon = Macaulay Duration**: The bond is nearly immune to interest rate risk. Here, price risk and reinvestment risk balance out.

## Duration Gap

This represents the difference between a bond's Macaulay duration and the investor's investment horizon. Duration gap=Macaulay duration?Investment horizon

A negative duration gap indicates that the bond's Macaulay duration is lower than the investment horizon of the investor. In this scenario, the primary concern is reinvestment risk, predominantly arising due to falling interest rates. On the other hand, a positive duration gap suggests that the bond's Macaulay duration is higher than the investor's investment horizon. Here, the main risk stems from potential price fluctuations, mainly driven by increasing interest rates.

Overall, the duration gap helps in identifying the primary source of interest rate risk a bond faces, be it from reinvestment or price changes.



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## Question

Which of the following statements about a bond with a Macaulay duration higher than the investment horizon is MOST accurate?

A. The bond predominantly faces reinvestment risk.
B. The bond is primarily exposed to price risk.
C. The bond is nearly hedged against interest rate risk.

**Solution**

**The correct answer is B:**

When the Macaulay duration of a bond is higher than the investment horizon, the bond is primarily exposed to price risk, especially from rising interest rates.

**A is incorrect:** This would be the case when the investment horizon is higher than the Macaulay duration.

**C is incorrect:** The bond is nearly hedged against interest rate risk when the investment horizon matches the Macaulay duration.



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## LOS 10c: define, calculate, and interpret Macaulay duration.

### Definition

Macaulay duration was introduced in the previous learning objective. It provides an understanding of the bond's sensitivity to interest rate fluctuations. At its core, Macaulay duration is the weighted average time until a bond's cash flows are received. It signifies the holding period for a bond that balances both reinvestment and price risk.

### Calculation

The calculation for Macaulay Duration is derived from the bond's cash flows. Each cash flow is weighted by its share of the bond's full price, which is its present value. The following steps outline the calculation:

i. **Time to Receipt of Cash Flow**: Determine the time until each cash flow is received.
ii. **Cash Flow**: Identify the cash flow amount for each period.
iii. **Present Value of Cash Flow**: Calculate the present value of each cash flow using the bond's yield-to-maturity.
iv. **Weight of Cash Flow**: Compute the weight of each cash flow by dividing its present value by the total present value of all cash flows.
v. **Weighted Average Time**: Multiply the time to receipt of each cash flow by its respective weight.
vi. **Macaulay Duration**: Sum up the results from step 5 to obtain the Macaulay Duration.

### Formula

The general formula to calculate Macaulay duration, represented as MacDur, is:

$$\text{MacDur} = \frac{\sum_{i=1}^{N} \frac{t \times CF_t}{(1+r)^t}}{\sum_{i=1}^{N} \frac{CF_t}{(1+r)^t}}$$

Where:



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- $t$ is the time (in periods) until the cash flow is received.
- $CF_t$ is the cash flow at time $t$.
- $r$ is the yield-to-maturity per period.
- $N$ is the total number of periods.

## Example: Calculating the Macaulay Duration

Consider a bond that has five years remaining to maturity, a coupon of 1% paid annually, and a yield-to-maturity of 0.10%. Assume it is 120 days into the first coupon period and uses a 30/360 day-count basis. The bond's annualized Macaulay duration is closest to:

Considerations:

1. The bond has a 1% annual coupon, which means a cash flow of 1 per year for the next 4 years and 101 ( 1 + 100 par value) in the 5th year.
2. The yield-to-maturity is 0.10% or 0.0010 in decimal form.
3. It is 120 days into the first coupon period, so the first cash flow will be received in $1 - \frac{120}{360}$ years or 0.6667 years.
4. Macaulay duration is calculated as:

$$\text{MacDur} = \frac{\sum_{i=1}^{N} \frac{t \times CF_t}{(1+r)^t}}{\sum_{i=1}^{N} \frac{CF_t}{(1+r)^t}}$$

Where:

- $CF_t$ = Cash Flow at time $t$
- $r$ = Yield to Maturity
- $t$ = Time to receipt of the cash flow



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| Period | Time to Receipt | Cashflow Amount | PV | Weight | Time to Receipt*Weight |
|---|---|---|---|---|---|
| 1 | 0.6667 | 1 | 0.9993 | 0.0096 | 0.01 |
| 2 | 1.6667 | 1 | 0.9983 | 0.0096 | 0.02 |
| 3 | 2.6667 | 1 | 0.9973 | 0.0095 | 0.03 |
| 4 | 3.6667 | 1 | 0.9963 | 0.0095 | 0.03 |
| 5 | 4.6667 | 101 | 100.5300 | 0.9618 | 4.49 |
| Total | | | 104.5213 | 1 | 4.5712 |

This means that an investor would, on average, wait **4.5712** years to receive the bond's cash flows, weighted by their present value.

## Interpretation of Macaulay Duration

The Macaulay Duration provides insights into the bond's interest rate risk. A bond with a higher Macaulay Duration has greater sensitivity to interest rate changes.

For instance, if the investment horizon matches the Macaulay Duration, the bond is nearly hedged against interest rate risk. Any losses due to rising interest rates (price risk) would approximately be offset by gains from the reinvestment of coupons (reinvestment risk), and vice versa.

Furthermore, the Macaulay Duration is often annualized. For bonds with semiannual coupons, the Macaulay Duration is divided by 2 to get the annualized figure.

It's also noteworthy that the Macaulay Duration is typically less than the bond's time-to-maturity because it's a present value-weighted average of the time until cash flows are received.



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## Question

Consider a bond that has three years remaining to maturity, a coupon of 3.5% paid semiannually, and a yield-to-maturity of 3.80%. Assuming it is 18 days into the first coupon period and using a 30/360 basis, the bond's annualized Macaulay duration is closest to:

A. 2.81495
B. 2.8233 years
C. 2.8483 years.

**Solution**

**The correct answer is C:**

Given:

- The bond has three years remaining to maturity.
- A coupon of 3.5% is paid semiannually.
- Yield-to-maturity is 3.80%.
- 18 days into the first coupon period.
- A 30/360 basis.

This means the bond pays 1.75% every 6 months. The yield per period is 1.90% (3.80% divided by 2).

Let's compute MacDur and then divide by 2 to annualize it, since the bond pays semiannually.



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| Period | Time to Receipt | Cashflow Amount | PV | Weights | Time to Receipt*Weight |
|---|---|---|---|---|---|
| 1 | 0.9500 | 1.75 | 1.7190 | 0.0173 | 0.02 |
| 2 | 1.9500 | 1.75 | 1.6869 | 0.0170 | 0.03 |
| 3 | 2.9500 | 1.75 | 1.6555 | 0.0167 | 0.05 |
| 4 | 3.9500 | 1.75 | 1.6246 | 0.0164 | 0.06 |
| 5 | 4.9500 | 1.75 | 1.5943 | 0.0161 | 0.08 |
| 6 | 5.9500 | 101.75 | 90.9700 | 0.9166 | 5.45 |
| | | | 99.2503 | 1.0000 | 5.6966 |

The annualized MacDur is **5.6966/2 =** 2.8483



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# Learning Module 11: Yield Based Bond Duration Measures and Properties

## LOS 11b: explain how a bond’s maturity, coupon, and yield level affect its interest rate risk.

The sensitivity of a bond's price to changes in interest rates can be captured using Macaulay duration, modified duration, money duration, and the price value of a basis point (PVBP).

## Relationships Between Bond Features and Duration

### Coupon rate (c))

An increase in the coupon rate leads to a decrease in duration (inverse relationship). Bonds with lower coupon rates have higher durations. This implies more interest rate risk for lower-coupon bonds.

### Yield to Maturity (r)

An increase in the yield to maturity results in a decrease in duration (inverse relationship). A bond with a lower yield-to-maturity will have a higher duration. This is because lower yields emphasize the weight of the bond's later cash flows, especially the maturity value.

### Time-to-Maturity

An increase in the time to maturity leads to an increase in duration (direct relationship). Bonds with longer times to maturity will generally have higher durations, suggesting greater interest rate risk. However, a peculiarity arises with long-dated discount bonds: their Macaulay duration can decrease after reaching a certain time-to-maturity.

### Fraction of current coupon period elapsed (t/T)



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An increase in $\frac{t}{T}$ leads to a decrease in duration (inverse relationship). As more time passes within a coupon period, the Macaulay duration decreases. However, once a coupon is paid, the duration jumps slightly, creating a "saw-tooth" pattern.



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## Question

Which of the following bonds is most likely to have the highest duration?

A. A bond with a high coupon rate and short time to maturity.
B. A bond with a low coupon rate and long time to maturity.
C. A bond with a high coupon rate and long time to maturity.

**Solution**

The correct answer is **B.**

Bonds with lower coupon rates and longer times to maturity typically have higher durations. This indicates greater interest rate risk for such bonds.

**A is incorrect:** A high coupon rate would lead to a lower duration.

**C is incorrect:** While a long time to maturity increases duration, a high coupon rate decreases it.



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**LOS 11a: define, calculate, and interpret modified duration, money duration, and the price value of a basis point (PVBP).**

# Modified Duration

Modified duration captures the sensitivity of a bond's price to fluctuations in its yield-to-maturity (YTM). This relationship provides insight into how bond prices vary with shifts in yield. Specifically, bond prices and yields exhibit an inverse relationship: as yields rise, bond prices fall, and vice versa.

## Relation to Macaulay Duration

Modified duration is an extension of the Macaulay duration, which conveys the weighted average time until a bond's cash flows are received. The link between these two measures is encapsulated by the formula:

$$\text{ModDur} = \frac{\text{Macaulay Duration}}{1 + r}$$

Where r represents the yield per period. To obtain the annual modified duration, divide the modified duration by the bond's number of coupon payments in a year. The larger the modified duration, the more pronounced the bond's price-yield curve becomes, leading to larger price swings for given changes in yield.

## Approximating Modified Duration

In cases where the Macaulay duration is not available, the modified duration can be estimated by observing minute variations in bond prices as yields change. This approximation method is especially useful for bonds with embedded options or inherent default risks. The formula for this approximation is:

$$\text{AnnModDur} \approx \frac{(PV_{-} - PV_{+})}{2 \times \Delta\text{Yield} \times PV_0}$$

Where $PV_{-}$ and $PV_{+}$ are bond prices corresponding to decreased and increased yields, respectively.



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Historically, this method has been highly accurate. To revert to the Macaulay duration, multiply the modified duration by $1 + r$.

## Example: Approximating Modified Duration

A 4.5% semiannual-pay fixed-coupon bond is issued at par on 1 June 2026 and matures on 1 June 2030. For a 50bps increase and decrease in yield-to-maturity, $PV_+$ and $PV_-$ are 98.207 and 101.831, respectively. The approximate modified duration can be determined as follows:

Formula:

$$\text{AnnModDur} \approx \frac{(PV_- - PV_+)}{2 \times \Delta\text{Yield} \times PV_0}$$

$PV_- = 101.831$

$PV_+ = 98.207$

$\Delta\text{Yield} = 50/10000 = 0.005$

$$\text{AnnModDur} \approx \frac{101.831 - 98.207}{2 \times 0.005 \times 100} = 3.624$$

## Predicting Price Changes Based on Modified Duration

Modified duration unveils the bond price-yield relationship, allowing predictions of the bond's percentage price alteration in relation to shifts in its YTM. The formula to determine this is:

$$\%\Delta PV^{\text{Full}} \approx -\text{AnnModDur} \times \Delta\text{AnnYield}$$

As an illustration, a bond with a modified duration of 5 would likely experience a 5% price drop if its yield surges by 100 basis points. Hence, bonds with higher modified durations exhibit steeper price-yield curves, making them more susceptible to yield variations. It's crucial to note that this formula offers a linear approximation for the inherently nonlinear price-yield relationship. The inclusion of the negative sign emphasizes the inverse correlation between bond prices and their yields-to-maturity.



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## Money Duration

While modified duration gauges the percentage price change of a bond given variations in its yield-to-maturity (YTM), money duration provides insights into the price change in terms of currency units. In the U.S., it is also referred to as "dollar duration."

Money duration is calculated using the formula:

$$\text{MoneyDur} = \text{AnnModDur} \times \text{PV}^{\text{Full}}$$

$\text{PV}^{\text{Full}\sim}$ can be either the bond price as a percent of par value or the currency value of the bond holding.

Using Money Duration, one can estimate the bond price change in currency units for a given change in YTM:

$$\%\Delta\text{PV}^{\text{Full}} \approx -\text{MoneyDur} \times \Delta\text{Yield}$$

### Example: Calculating Money Duration

Consider a bond with an annualized modified duration of 5.5, a coupon of 4% and a price of 102. The money duration is closest to:

$$\text{MoneyDur} = \text{AnnModDur} \times \text{PV}^{\text{Full}}$$

$$\text{Money Duration} = 5.5 \times 102$$

This means that for a 1% (or 100 basis points) change in yield, the bond's price will change by $561.

## Price Value of a Basis Point (PVBP)

PVBP provides an estimate of the change in the full price of a bond for a minuscule 1bp change in its YTM. PVBP can be determined using the formula:



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$$PVBP = \frac{(PV_-) - (PV_+)}{2}$$

This measure is often termed as "PV01" or in the U.S., "DV01" (Dollar Value of 1bp). PVBP is especially handy for bonds where future cash flows are unpredictable, like callable bonds.

Basis Point Value (BPV) is a close relative to PVBP, and it is the product of Money Duration and 0.0001 (1bp).



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## Question

An investment analyst is reviewing a 4-year bond, issued on 1 January 2024, set to mature on 1 January 2028. This bond features a 4% coupon rate, paid semi-annually, and carries a yield-to-maturity of 6%. The bond's annualized Macaulay duration and Modified duration, respectively, are *closest to:*

A. 3.46 and 3.26

B. 3.69 and 3.48

C. 3.72 and 3.62

**Solution**

**The correct answer is C:**

The Macaulay duration is 7.4481. This can be annualized by dividing by the number of coupon payments in a year.

| Period | Time to receipt | Cashflow amount | PV | Weights | Time to Receipt*Weight |
|---|---|---|---|---|---|
| 1 | 1.0000 | 2 | 1.9417 | 0.0209 | 0.0209 |
| 2 | 2.0000 | 2 | 1.8852 | 0.0203 | 0.0406 |
| 3 | 3.0000 | 2 | 1.8303 | 0.0197 | 0.0591 |
| 4 | 4.0000 | 2 | 1.7770 | 0.0191 | 0.0764 |
| 5 | 5.0000 | 2 | 1.7252 | 0.0186 | 0.0928 |
| 6 | 6.0000 | 2 | 1.6750 | 0.0180 | 0.1081 |
| 7 | 7.0000 | 2 | 1.6262 | 0.0175 | 0.1224 |
| 8 | 8.0000 | 102 | 80.5197 | 0.8660 | 6.9279 |
| Total | | | 92.9803 | 1.0000 | 7.4481 |

$$\text{Annualized Macaulay duration} = \frac{7.4481}{2} = 3.72405$$

$$\text{ModDur} = \frac{3.72405}{1.03} = 3.6156$$



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# Learning Module 12: Yield Based Bond Convexity and Portfolio Properties

## LOS 12a: calculate and interpret convexity and describe the convexity adjustment.

Duration provides a linear approximation of the change in a bond's price with respect to changes in yield. On the other hand, convexity measures the non-linear, second-order effect of yield changes on a bond's price. It captures the curvature of the price-yield relationship.

While duration estimates price changes linearly, the true bond price-yield relationship is convex. Convexity becomes particularly crucial when considering significant yield changes and for bonds with longer maturities.

### Calculating Convexity

Convexity can be calculated using the formula:

$$\%\Delta P_{VFull} \approx (-\text{AnnModDur} \times \Delta\text{Yield}) + [\frac{1}{2} \times \text{AnnConvexity} \times (\Delta\text{Yield})^2]$$

The first term captures the effect from modified duration. The second term represents the convexity adjustment.

Convexity can also be approximated using the following formula:

$$\text{ApproxCon} = \frac{(PV_-) + (PV_+) - [2 \times (PV_0)]}{(\Delta\text{Yield})^2 \times (PV_0)}$$

### Factors Affecting Convexity

i. Maturity: Longer maturity increases convexity.
ii. Coupon rate: Lower coupon rate increases convexity.
iii. YTM: Lower YTM increases convexity.
iv. Cash Flow Dispersion: For two bonds with the same duration, the one with more dispersed



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cash flows will have greater convexity.

## Benefits of Convexity

Bonds with greater convexity perform better in both rising and falling yield scenarios, making them less risky for investors. This assumes that the difference in convexity is not reflected in the bond's price. For large yield changes, a bond's price will rise more with a decrease in yield and fall less with an increase in yield if it has higher convexity.

## Example: Calculating Convexity

Consider a bond that has a term to maturity of 3 years, an annual coupon rate of 2%, a yield-to-maturity (YTM) of 2%, and is priced at 100 per 100 par value.

i. Calculate the modified duration and convexity for the bond at issuance.
ii. Calculate ApproxModDur and ApproxCon for the bond using a 10 bp increase and decrease in the yield-to-maturity.

**Calculating Modified Duration and Convexity**

| Period | Time to Receipt | Cashflow Amount | Present Value | Weights | Time to Receipt*Weight | C |
|---|---|---|---|---|---|---|
| 1 | 1.0000 | 2 | 1.9608 | 0.01960 | 0.02 | |
| 2 | 2.0000 | 2 | 1.9223 | 0.01922 | 0.04 | |
| 3 | 3.0000 | 102 | 96.1169 | 0.96118 | 2.88 | |
| Total | | | 100.0000 | 1.0000 | 2.94 | |

Annualized Macaulay Duration = 2.94

Annualized convexity = 11.46

Convexity for each period has been calculated as:

$$\text{Convexity} = \text{Time to receipt of cashflows} \times (\text{Time to receipt of cashflows} + 1) \times \text{Weight} \times (1 + \frac{YTM}{m}$$

Where m is the periodicity.



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## Calculating ApproxModDur and ApproxCon

$$\text{ApproxCon} = \frac{(PV_-) + (PV_+) - [2 \times (PV_0)]}{(\Delta\text{Yield})^2 \times (PV_0)}$$

$$PV_0 = \frac{2}{1.02} + \frac{2}{1.02^2} + \frac{102}{1.02^3} = 100$$

$$PV_- = \frac{2}{1.019} + \frac{2}{1.019^2} + \frac{102}{1.019^3} = 100.288951$$

$$PV_+ = \frac{2}{1.021} + \frac{2}{1.021^2} + \frac{102}{1.021^3} = 99.71217249$$

$$\text{ApproxCon} = \frac{100.288951 + 99.71217249 - [2 \times 100]}{(0.001)^2 \times (100)} = 11.2349$$



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## Question

Which of the following factors *most likely* increases the convexity of a bond?

A. Higher coupon rate
B. Shorter maturity
C. Lower yield-to-maturity (YTM)

**Solution**

**The correct answer is C:**

Lower YTM increases convexity.

**A is incorrect:** Lower coupon rates, not higher, increase convexity.

**B is incorrect:** Longer maturities, not shorter, increase convexity.



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## LOS 12b: calculate the percentage price change of a bond for a specified change in yield, given the bond's duration and convexity.

The percentage price change of a bond, given a specified change in yield, can be more accurately estimated using both the bond's duration and convexity compared to using duration alone. We will give an example to illustrate this.

Consider a 2-year, 4% semiannual coupon bond, settling on 10 June 2024, maturing on 10 June 2026, and yielding 4%—thus, priced at par. Suppose the investor has a position in the bond with a par value of USD50 million, and the yield-to-maturity increases by 100 bps.

### Calculating the Actual Prices

$$PV_0 = \frac{2}{1.02} + \frac{2}{1.02^2} + \frac{2}{1.02^3} + \frac{102}{1.02^4} = 100$$

100bp decrease in yield (3%)

$$PV_- = \frac{2}{1.015} + \frac{2}{(1.015)^2} + \frac{2}{(1.015)^3} + \frac{102}{(1.015)^4} = 101.9271923$$

$$\%\Delta PV^{Full} = \frac{101.9271923}{100} - 1 = 1.9272\%$$

100bp increase in yield (5%)

$$PV_+ = \frac{2}{1.025} + \frac{2}{(1.025)^2} + \frac{2}{(1.025)^3} + \frac{102}{(1.025)^4} = 98.1190129$$

$$\%\Delta PV^{Full} = \frac{98.1190129}{100} - 1 = -1.8810\%$$

### Calculating the Modified Duration



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| Period | Time to Receipt | Cashflow Amount | PV | Weights | Time to Receipt*Weight | Conve |
|---|---|---|---|---|---|---|
| 1 | 1.0000 | 2.0000 | 1.9608 | 0.0196 | 0.0196 | |
| 2 | 2.0000 | 2.0000 | 1.9223 | 0.0192 | 0.0384 | |
| 3 | 3.0000 | 2.0000 | 1.8846 | 0.0188 | 0.0565 | |
| 4 | 4.0000 | 102.0000 | 94.2322 | 0.9423 | 3.7693 | |
| | | | 100.0000 | 1.0000 | 3.8839 | |

$$\text{Annualized Macaulay duration} = \frac{3.8839}{2} = 1.94195$$

$$\text{Annualized convexity} = \frac{18.4805}{2^2} = 4.620125$$

$$\text{Modified duration} = \frac{1.94195}{1 + \frac{0.04}{2}} = 1.9039$$

So, a 100bp increase (decrease) in yield-to-maturity results in %ΔPVFull ?–1.9039% (1.9039%)

**Adding Convexity Adjustment to the Duration Estimate:**

$$\%\Delta P_{VFull} \approx (-\text{AnnModDur} \times \Delta\text{Yield}) + [\frac{1}{2} \times \text{AnnConvexity} \times (\Delta\text{Yield})^2]$$

$$\%\Delta P_{VFull} \approx (-1.9039 \times -0.01) + [\frac{1}{2} \times 4.6201 \times (-0.01)^2] = 1.9270\%$$

$$\%\Delta P_{VFull} \approx (-1.9039 \times 0.01) + [\frac{1}{2} \times 4.6201 \times (0.01)^2] = -1.8808\%$$

The results can be summarized in the following table:

| Change in yield | Actual $\%\Delta PV_{Full}$ | Estimated using ModDur | Difference from actual change | Estimated using ModDur and Convexity | Differen actual c |
|---|---|---|---|---|---|
| −100bps | 1.9272% | 1.9039% | −0.0233% | 1.9270% | −0.00 |
| +100bps | −1.8810% | −1.9039% | −0.0229% | −1.8808% | 0.00 |

Notice the enhanced precision after adding the convexity adjustment, shown by the decreased difference from the actual change.

Money duration and money convexity capture the first-order and second-order effects on the full price of a bond in currency units, respectively. The money convexity is calculated using the formula:



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$$\text{MoneyCon} = \text{AnnConvexity} \times \text{PV}_{\text{Full}}$$

The change in the bond's full price using Money Duration and Money Convexity is calculated using the formula:

$$\Delta \text{PV}_{\text{Full}} \approx -(\text{MoneyDur} \times \Delta\text{Yield}) + [\frac{1}{2} \times \text{MoneyCon} \times (\Delta\text{Yield})^2]$$

**Question**

An investor purchases a £5 million semi-annual 2.5% coupon bond with a yield-to-maturity of 1.75%, settling 01 July 2023 and maturing 01 July 2025. The bond's ApproxCon using a 1 bp increase and decrease in yield-to-maturity is *closest to:*

A. 1.9464

B. 4.9277

C. 19.1756

**Solution**

**The correct answer is B:**

$$\text{ApproxCon} = \frac{(\text{PV}_-) + (\text{PV}_+) - [2 \times (\text{PV}_0)]}{(\Delta\text{Yield})^2 \times (\text{PV}_0)}$$

$$\text{PV}_0 = \frac{1.25}{1.00875} + \frac{1.25}{1.00875^2} + \frac{1.25}{1.00875^3} + \frac{101.25}{1.00875^4} = 101.467753$$

$$\text{PV}_- = \frac{1.25}{1.00870} + \frac{1.25}{(1.00870)^2} + \frac{1.25}{(1.00870)^3} + \frac{101.25}{(1.00870)^4} = 101.4875066$$

$$\text{PV}_+ = \frac{1.25}{1.00880} + \frac{1.25}{(1.00880)^2} + \frac{1.25}{(1.00880)^3} + \frac{101.25}{(1.00880)^4} = 101.4480044$$

$$\text{ApproxCon} = \frac{((101.4875066 + 101.4480044) - (2 \times 101.467753))}{(0.0001)^2 \times 101.467753} = 4.9277$$



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## LOS 12c: calculate portfolio duration and convexity and explain the limitations of these measures.

Duration and convexity can be used to measure the interest rate risk of a portfolio of bonds, similar to a single bond. There are two methods to calculate the duration and convexity of a bond portfolio:

i. Using the weighted average of time to receipt of the aggregate cash flows.
ii. Using the weighted averages of the durations and convexities of the individual bonds in the portfolio.

The first technique is theoretically more precise. However, its practical application proves challenging. Consequently, the emphasis tends to lean towards the second approach, largely due to its common usage among fixed-income portfolio managers. However, it operates under the assumption that yield changes are uniform across all maturities, leading to a parallel shift in the yield curve. Contrary to this assumption, yield curve shifts are typically observed as steepening, flattening, or even twisting yield curves, making pure parallel shifts rare.

**Example: Calculating Weighted Average Duration and Convexity**

An investor purchases $5 million par value of a 4-year, zero-coupon bond and a 5-year, fixed-rate semi-annual coupon bond. Details of the bonds are shown below.

| Bond | Maturity (Years) | Coupon (%) | Price | YTM (%) | Duration | Convexity |
|---|---|---|---|---|---|---|
| Zero | 4 | 0 | 87.1442228 | 3.5 | 3.8647 | 19.32367 |
| Semi-annual | 5 | 4.5 | 101.115515 | 4.25 | 4.441605 | 23.12742 |

i. Calculate the weighted-average modified duration for the portfolio.
ii. Calculate the weighted-average convexity for the portfolio.
iii. Calculate the estimated percentage price change of the portfolio given a 100 bp increase in yield-to-maturity on each of the bonds.

## Calculating the weighted-average modified duration for the portfolio.

To compute the weighted-average modified duration:



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### Determine the market value for each bond.

Zero-coupon bond: $87.1442228 \times \$5,000,000 = 435,721,114$

Semi-Annual Bond: $101.115515 \times 5,000,000 = 505,577,575$

### Calculate the weight for each bond.

$$\text{Total market value} = 435,721,114 + 505,577,575 = 941,298,689$$

$$\text{Weight of Zero} - \text{coupon bond}: 435,721,114/941,298,689 = 0.46289357$$

$$\text{Weight of Semi} - \text{Annual Bond}: 505,577,575/941,298,689 = 0.537106426$$

### Multiply the weight of each bond by its duration and sum the results.

$\text{Weighted} - \text{average modified duration} = (0.46289357 \times 3.8647 + (0.537106426 \times 4.441605) = 4.17455$

### Calculating the weighted-average convexity for the portfolio.

Similar to the duration calculation above:

1. Determine the market value for each bond (which we have already done in step i).
2. Calculate the weight for each bond (which we have also done in step ii).
3. Multiply the weight of each bond by its convexity and sum the results.

$\text{Weighted} - \text{average convexity} = (0.46289357 \times 19.32367 + (0.537106426 \times 23.12742) = 21.366688$

### Calculating the estimated percentage price change of the portfolio given a 100 bp increase in yield-to-maturity on each of the bonds.

$$\%\Delta PV_{Full} \approx (-\text{Duration} \times \Delta y) + [\frac{1}{2} \times \text{Convexity} \times (\Delta y)^2]$$

Where $\Delta y$ is the change in yield (in decimal form).

For a 100bp change, ?y=0.0100.



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$$\%\Delta P\ V_{Full} \approx (-4.174559367 \times 0.01) + [\frac{1}{2} \times 21.36668849 \times (0.01)^2] = -0.040677259 \approx -4.0677\%$$



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## Question

Given that a bond portfolio has a duration of 5 years and a convexity of 50, estimate the percentage change in the portfolio's value if there is an increase of 50 basis points in the yield-to-maturity.

A. -2.438%

B. -2.500%

C. 2.563%

**Solution**

The correct answer is A.

Formula:

$$\%\Delta PV_{Full} \approx (-\text{Duration} \times \Delta y) + [\frac{1}{2} \times \text{Convexity} \times (\Delta y)^2]$$

Where ?y for 50 basis points is 0.005

$$\%\Delta PV_{Full} \approx (-5 \times 0.005) + [\frac{1}{2} \times 50 \times (0.005)^2] = -2.438\%$$



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# Learning Module 13: Curve Based and Empirical Fixed Income Risk Measures

## LOS 13a: explain why effective duration and effective convexity are the most appropriate measures of interest rate risk for bonds with embedded options.

Yield duration and convexity assume predictable bond cash flows. However, bonds with embedded options, e.g., callable or puttable bonds, have future cash flows which are uncertain. The option is exercised based on market interest rates relative to the coupon interest paid or received. Bonds with embedded options do not have clear-cut yield-to-maturity. For such bonds, traditional measures like Macaulay and modified durations do not accurately capture interest rate risk. Instead, "effective duration" is used, which focuses on how the bond's price reacts to changes in a benchmark yield curve, like the government par curve. Finally, while the interest rate risk estimates of yield and convexity are only useful for small changes in yields, the estimates from effective duration and convexity are useful for both small and large yield changes.

## Effective Duration

Effective duration serves as an essential tool in measuring the bond's price sensitivity to changes in the benchmark yield curve. The formula for calculating effective duration (EffDur), which is very similar to the one for determining the approximate modified duration, is expressed as:

$$\text{EffDur} = \frac{(PV_- - PV_+)}{2 \times (\Delta\text{Curve}) \times (PV_0)}$$

Where:

- $PV_-$ and $PV_+$: The present values are calculated using option pricing models when the interest rate is decreased and increased, respectively.
- $\Delta$Curve: The change in the benchmark yield curve.
- $PV_0$: The present value at the current interest rate.



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### Effective Duration for Callable and Non-Callable Bonds

Non-callable bonds are consistently priced higher than callable bonds due to the value of the embedded call option held by the issuer. When interest rates are low, the value of the call option in callable bonds rises; this limits the bond's price appreciation. Effective durations of callable and non-callable bonds are similar when yields are high. However, for low interest rates, callable bonds have a lower effective duration because of the presence of the call option.

### Effective Duration for Putable and Non-Putable Bonds

Putable bonds allow investors to sell them back to the issuer before maturity at face value. This provision protects investors from benchmark yield increases that could lower the bond's price below par. A putable bond's price is always greater than its non-putable counterpart due to the value of the embedded put option. Put options minimize bond sensitivity, especially during rising interest rates, in terms of effective duration. When rates are lower than the bond's coupon rate, the put option's value is limited, hence the bond's market reaction to yield changes resembles non-putable bonds. As benchmark rates rise, the put option's value rises, protecting investors from price declines.

## Effective Convexity

Effective convexity analyzes the second-order effects of shifts in the benchmark yield curve. It helps in understanding the potential changes in curve shape and the transition into negative regions, particularly when the value of the embedded call option increases. The formula for calculating effective convexity (EffCon) is:

$$\text{EffCon} = \frac{[(\text{PV}_- + \text{PV}_+) - 2 \times \text{PV}_0]}{(\Delta\text{Curve})^2 \times \text{PV}_0}$$

When the benchmark yield falls, non-callable bonds' price-yield curve steepens, suggesting positive convexity. The curve of callable bonds flattens and even turn negative when the benchmark yield falls. Both bond types have positive convexity at high benchmark yields. As yields fall, the callable



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bond may become negative convexity due to the embedded call option's value.

On the other hand, putable bonds are characterized by positive convexity. The embedded put option protects investors, especially during rising interest rates. This option lets investors sell the bond back to the issuer at par, limiting price losses.

Effective duration and convexity are also relevant for mortgage-backed securities (MBSs). MBSs cash flows depend on homeowners' refinancing decisions, especially prevalent in areas where refinancing is common during low-interest-rate scenarios.

## Example: Interest Rate Sensitivity of a Callable Bond

A portfolio manager is contemplating investing in a callable bond and approaches you, the lead analyst in the fixed-income team, to assess its interest rate sensitivity. The manager has a preference for bonds with a duration between 6 and 7 years and a positive convexity. The full price of the callable bond is 105.50 per 100 of par value. When the government par curve shifts by 30bps, your option valuation model indicates the new full prices for this callable bond are 103.40 when raised and 107.350 when lowered. Therefore:

- $PV_0 = 105.500$
- $PV_+ = 103.400$
- $PV_- = 107.350$
- $\Delta Curve = 0.0030$

Using the provided data, you calculate the effective duration and effective convexity for this callable bond as:

$$EffDur = \frac{(PV_- - PV_+)}{2 \times \Delta Curve \times PV_0}$$

$$EffDur = \frac{(107.350 - 103.400)}{2 \times 0.0030 \times 105.500} = 6.2401$$



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$$\text{EffCon} = \frac{(PV_- + PV_+) - 2 \times PV_0}{\Delta\text{Curve}^2 \times PV_0}$$

$$\text{EffCon} = \frac{(107.350 + 103.400) - 2 \times 105.500}{(0.0030)^2 \times 105.500} = -263.296$$

Based on your analysis, you advise the portfolio manager to exercise caution when considering this callable bond. Although its effective duration is within the desired range, the bond exhibits negative effective convexity. A bond displaying negative effective convexity will experience a more pronounced decrease in its price due to a rise in the benchmark yield compared to the price increase resulting from a decrease in the benchmark yield.



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## Question

An investor plans to allocate $500,000 in two-year Mega-Corp bonds. One of the bonds, Bond X, is standard, while Bond Y has an embedded put option. Which duration metric is best suited to assess the interest rate risk for these bonds?

A. Money duration
B. Effective duration
C. Macaulay duration

**Solution**

The correct answer is **B.**

Bond Y has an embedded put option, introducing optionality to the bond. Bonds with embedded options, such as callable or putable bonds, have uncertain future cash flows because the exercise of the option depends on market interest rates relative to the bond's coupon interest. Since these bonds do not have clearly defined yields-to-maturity, traditional measures like Macaulay and modified durations are not suitable. Instead, effective duration, which measures a bond's price sensitivity to changes in a benchmark yield curve (like the government par curve), is the appropriate measure for bonds with embedded options.Therefore, effective duration is the best measure to use. Effective duration is also applicable for bonds without embedded options, enabling the investment advisor to compare the interest rate risks of both Bond X and Bond Y.

**A is incorrect.** While money duration measures the sensitivity of the bond's price to interest rate changes, it does not specifically cater to bonds with embedded options.

**C is incorrect.** Macaulay duration provides the weighted average time until a bond's cash flows are received, but it does not adjust for embedded options.



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## LOS 13b: calculate the percentage price change of a bond for a specified change in benchmark yield, given the bond's effective duration and convexity.

Effective duration and effective convexity are curve-based metrics that are crucial for assessing the interest rate risk of complex instruments, such as those with embedded contingency provisions. These metrics are typically determined from bond prices derived using an option valuation model, given specific changes in the underlying benchmark government yield curve. Effective duration and effective convexity can be used to estimate the percentage change in a bond's full price for a given shift in the benchmark yield curve (?Curve). It is calculated as:

$$\%\Delta PV^{Full} \approx (-EffDur \times \Delta Curve) + [\frac{1}{2} \times EffCon \times (\Delta Curve)^2]$$

### Example: Bond Price Impact from Par Curve Shifts

Consider the effective duration and effective convexity data for Bond X and Bond Y. We will examine the effects of a 200bps shift in the benchmark government par curve.

| Bond | EffDur | EffCon |
|---|---|---|
| Bond X | 7.425 | −295.0 |
| Bond Y | 6.891 | −278.310 |

**Upward Shift by 200 bps:**

$$\%\Delta PV^{Full} \approx (-EffDur \times \Delta Curve) + [\frac{1}{2} \times EffCon \times (\Delta Curve)^2]$$

Where $\Delta Curve = 0.02$,

Bond X: $\%\Delta PV^{Full} = (-7.425 \times 0.02) + (0.5 \times -295.0 \times (0.02)^2) = -20.75\%$

Bond Y: $\%\Delta PV^{Full} = (-6.891 \times 0.02) + (0.5 \times -278.310 \times (0.02)^2) = -19.35\%$

The significant decline in bond prices in response to increasing interest rates can be attributed to the high effective durations of Bond X and Bond Y, indicating their increased vulnerability to changes



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in interest rates. The situation is compounded by the negative convexities, which amplify the declines in bond prices. Investors who hold these bonds are, therefore, at risk of incurring losses in the event of rising interest rates. The negative convexity also indicates that bond prices may not experience significant increases even if interest rates subsequently decrease, as we will see below.

**Downward Shift by 200 bps:**

$\Delta Curve = -0.02$.

$Bond\ X: \%\Delta PV^{Full} = (-7.425 \times -0.02) + (0.5 \times -295.0 \times (-0.02)^2) = 8.95\%$

$Bond\ Y: \%\Delta PV^{Full} = (-6.891 \times -0.02) + (0.5 \times -278.310 \times (-0.02)^2) = 8.22\%$

Despite declining interest rates, the price appreciation of both bonds is moderate. This seemingly counterintuitive behavior can be attributed back to the negative convexities of the bonds. In rate-declining scenarios, one would anticipate bond prices to rise more significantly. However, the negative convexity lowers this increase, causing the price appreciation to be less than would be predicted based solely on duration.



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## Question

The effective duration and effective convexity of a bond are 4.816 and 26.723, respectively, The percentage changes in the bond's full price for ±100bp shifts in the benchmark government par curve are closest to?

A. -4.68% and 4.95%

B. -4.47% and 4.71%

C. -4.816% and 26.72%

**Solution**

**The correct answer is A:**

$$\%\Delta PV^{Full} \approx (-EffDur \times \Delta Curve) + [\frac{1}{2} \times EffCon \times (\Delta Curve)^2]$$

**Upward shift:**

$$\Delta Curve = 0.01$$

$$\%\Delta PV^{Full} = (-4.816 \times 0.01) + (0.5 \times 26.723 \times (0.01)^2) = -4.68\%$$

**Downward shift:**

$$\Delta Curve = -0.01$$

$$\%\Delta PV^{Full} = (-4.816 \times -0.01) + (0.5 \times 26.723 \times (-0.01)^2) = 4.95\%$$



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## LOS 13c: define key rate duration and describe its use to measure price sensitivity of fixed-income instruments to benchmark yield curve changes.

Key rate duration (partial duration) is a financial metric that measures the sensitivity of a bond's price to changes in interest rates at specific points along the yield curve. On the other hand, effective duration gauges sensitivity to overall parallel shifts in the benchmark curve. Key rate durations sum up to the effective duration. To compute key rate durations, only specific points on the yield curve (e.g., 2-year, 5-year rates) are adjusted rather than the entire curve.

Key rate duration helps identify shaping risk — a bond's reaction to changes in the shape of the yield curve. For bonds with embedded options (e.g., callable bonds), the shape of the curve matters. A downward shift can impact the bond's price due to its negative convexity.

Key rate duration can be calculated using the following formula:

$$\text{KeyRateDur}_k = -\frac{1}{PV} \times \frac{\Delta PV}{\Delta r_k}$$

Where:

$\Delta r_k$ represents the change in the kth key rate.

$\triangle$ PV is the change in the bond's price.

PV is the bond's initial price.

The sum of key rate durations results to effective duration as per the following formula.

$$\sum_{k=1}^{n} \text{KeyRateDur}_k = \text{EffDur}$$

The percentage change in bond price is expressed mathematically as:

$$\frac{\Delta PV}{PV}(\%\Delta PV) = -\text{KeyRateDur}_k \times \Delta r_k$$

## Example: Analyzing Bond Price Sensitivity to Non-Parallel Shifts in the



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## Benchmark Government Par Curve

Consider a scenario with non-parallel shifts in the benchmark government par curve, characterized by a pronounced steepening at longer maturities. We will determine the expected price change for each of the two bonds, Bond C and Bond D, as a result of these shifts.

**Shifts in Benchmark Government Par Curve:**

| Maturity | Expected Change |
|---|---|
| 1 year | +80 bps |
| 5 years | +120 bps |
| 10 years | +180 bps |
| 20 years | +230 bps |
| 30 years | +280 bps |

**Bond Details**

| Bond | Tenor | Key Rate Duration |
|---|---|---|
| Bond C | 5 years | 2.30 |
| Bond D | 10 years | 3.60 |

We can compute the expected percentage price change for each bond using the following formula:

$$\frac{\Delta PV}{PV}(\%\Delta PV) = -\text{KeyRateDur}_k \times \Delta r_k$$

For Bond C:

$$\%\Delta PV_{\text{Bond C}} = -2.30 \times 1.20\% = -2.76\%$$

For Bond D:

$$\%\Delta PV_{\text{Bond D}} = -3.60 \times 1.80\% = -6.48\%$$

Bond D's price is more sensitive to the shifts, decreasing by roughly 6.48%, compared to Bond C's decrease of 2.76%. This is attributed to Bond D's higher key rate duration.

While understanding the portfolio duration and the general shift of the benchmark yield curve offers



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a rapid assessment of potential profits or losses, employing key rate durations enables a portfolio manager to adjust weights in specific tenors to optimize the risk-adjusted return.



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## Question #1

Which of the following best describes the key rate duration of a bond?

A. The bond's sensitivity to a uniform change in all yields of the benchmark yield curve.
B. The bond's sensitivity to a change in the benchmark yield at a specific maturity.
C. The bond's sensitivity to changes only in the short-term rates of the benchmark yield curve.

**Solution:**

**The correct answer is B:**

Key rate duration (or partial duration) measures a bond's sensitivity to a change in the benchmark yield at a specific maturity.

**A is incorrect:** This description aligns with effective duration, which measures a bond’s sensitivity when all yields of the benchmark change uniformly.

**C is incorrect:** Key rate duration refers to sensitivity at a specific maturity, not just short-term rates.

## Question #2

In the context of key rate durations, "shaping risk" for a bond most likely refers to:

A. The risk that all yields on the benchmark curve will change by the same amount.
B. The risk associated with changes in the shape of the benchmark yield curve, such as steepening, flattening, or twisting.
C. The risk that only short-term rates on the benchmark curve will change.

**Solution:**

**The correct answer is B:**



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"Shaping risk" refers to a bond's sensitivity to changes in the shape of the benchmark yield curve, such as it becoming steeper, flatter, or undergoing a twist.

**A is incorrect:** This is a description of a parallel shift, not shaping risk.

**C is incorrect:** Shaping risk refers to changes in the entire shape of the curve, not just short-term rates.



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## LOS 13d: describe the difference between empirical duration and analytical duration.

Analytical duration utilizes mathematical models, assuming credit spreads and government bond yields are uncorrelated and independent. It is a solid method for estimating the bond's price-yield relationship in numerous situations. On the other hand, empirical duration relies on historical data within statistical frameworks, factoring in elements influencing bond prices. It recognizes the correlations between credit spreads and benchmark yields, enhancing its precision in specific contexts. It becomes particularly relevant during periods of economic unrest, like financial crises when the relationship between bond yields and spreads becomes more complex.

### Summary of the Important Duration Measures and their Significance

- Approximate Modified Duration: It is an approach based on yield that estimates the slope of a bond's price-yield curve. It estimates the modified duration of a bond.
- Effective Duration: It is a curve-based method used to estimate a bond's price sensitivity to a change in a benchmark yield curve. It estimates the modified duration for complex bonds whose cashflows are uncertain.
- Key Rate: It measures the sensitivity of a bond's price to changes in interest rates at specific points along the yield curve. It measures the sensitivity of a bond’s price to non-parallel shifts in the benchmark yield curve.
- Empirical Duration: Statistical estimate that considers the correlation between yield spreads and benchmark yield changes across different economic scenarios.

### Flight to Quality

In times of economic uncertainty, investors often shift from risky assets to secure ones, like government bonds. This can lead to a decline in government benchmark yields and widening credit spreads. During crises like COVID-19, "flight to quality" can cause government benchmark yields to fall while credit spreads widen.



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## Empirical vs. Analytical Duration: Practical Implications

For government bonds with minimal credit risk, analytical and empirical durations are similar. On the other hand, for corporate bonds, especially during market downturns, empirical duration is more relevant because of the negative correlation between benchmark yields and credit spreads.

Analysts must weigh the interplay between benchmark yields and credit spreads when determining which duration type to employ, ensuring accurate bond price predictions in varied economic contexts.



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## Question

In which scenario would empirical duration *most likely* provide more accurate estimates than analytical duration?

A. For government bonds with low credit risk during stable economic conditions.
B. For corporate bonds during periods of economic volatility where there's a "flight to quality."
C. For bonds when, government bond yields and credit spreads are perfectly positively correlated.

**Solution**

The correct answer is **B.**

For corporate bonds during periods of economic volatility where there's a "flight to quality."

**A is incorrect.** For government bonds with low credit risk, analytical and empirical durations are expected to provide similar estimates, especially in stable economic conditions.

**C is incorrect.** The situation described is not typical; during periods like economic crises, credit spreads and benchmark yields tend to be negatively correlated.



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# Learning Module 14: Credit Risk

## LOS 14a: describe credit risk and its components, probability of default and loss given default.

Credit risk arises when there is a potential for a borrower to default on their obligations, specifically by failing to fulfill their interest and principal payment obligations on a bond or loan. This particular risk, which originates from a contractual relationship, presents a significant performance risk that investors in fixed-income securities must effectively manage. The size of its impact is influenced not just by borrower-specific circumstances but also by the wider economic context.

## Traditional Credit Analysis - The "Cs"

In order to assess the creditworthiness of a borrower, analysts commonly utilize a set of metrics known as the "Cs". The five criteria below pertain to the detailed, individual-level factors relevant to a specific borrower, also known as bottom-up factors.

1. Capacity: Assesses the borrower's ability to make debt payments in a timely manner.
2. Capital: This metric indicates the extent of available resources that the borrower may rely on, hence lowering their reliance on debt.
3. Collateral: The assets that serve as a foundation for the borrower's indebtedness.
4. Covenants: Legally binding obligations that the borrower is obligated to adhere to.
5. Character: A qualitative metric used to evaluate the quality of management and their willingness to fulfill their financial obligations.

### Broader Economic Influences on Credit Risk (Top-Down Factors)

In addition to the above borrower-specific measures, credit risk is influenced by three broad aspects.

1. Conditions: Encompasses the current economic and business environment.
2. Country: Considers geopolitical intricacies alongside the legal and political framework of the



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borrower's jurisdiction.

3. Currency: Examines the implications of fluctuations in exchange rates or liabilities denominated in foreign currency.

## Sources of Repayment for Different Bonds

Corporations primarily rely on business operations, investment, and financing activities for repayment, while secondary sources include asset sales, divestitures, and additional debt issuances. The associated credit risks encompass economic contraction, strategic market shifts, heightened competition, and diminished pricing power. In contrast, sovereign or public entities derive their main repayment from corporate and personal taxes and from issuing new debt, with risks tied to shrinking operating margins and escalating losses.

A borrower might be illiquid, meaning they cannot access funds to make a payment, which differs from being insolvent, where the borrower's liabilities surpass their assets.

## Components of Credit Risk

### Probability of Default (POD)

This metric gauges the likelihood of a borrower not meeting payment obligations fully and on time. A combination of lower profitability, lower coverage (e.g., EBIT to interest expense), and increased leverage suggests a higher POD, indicating lower credit quality for corporate issuers.

### Loss Given Default (LGD)

The concept of LGD pertains to the possible financial loss that an investor may experience in the event of a default. LGD is calculated by multiplying the Exposure at Default (EE) by the complement of the Recovery Rate (RR).

$$\text{LGD} = \text{EE} \times (1 - \text{RR})$$

Where:

- EE (Expected Exposure) is the expected claim at default, typically the loan or bond face



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value plus accrued interest minus the current collateral's market value.

- RR (Recovery Rate) represents the percentage of the debt claim recovered upon default.

**Expected Loss (EL)**

The expected loss (EL) is a function of both POD and LGD and is expressed as:

$$EL = POD \times LGD$$

Investors assess their compensation for credit risk by comparing the expected loss to the credit spread over a given period. The credit spread, which signifies the additional yield a risky bond offers over a risk-free rate, serves as a metric for the reward an investor anticipates for bearing credit risk. Investors are deemed fairly compensated if the credit spread aligns with the expected loss.

The relationship between credit spread and expected loss can be approximated as:

$$\text{Credit Spread} \approx POD \times LGD$$

The risk of expected loss for investment-grade debt is primarily due to a rise in POD. High-yield investors seek covenant restrictions and/or security to lower LGD.

## Example: Credit Spread

An investor reviews ClearSky Enterprises' unsecured debt and finds a POD of 3% and an LGD of 75%. With an actual credit spread of 250 bps per year, the investor would expect to be more than fairly compensated for assuming ClearSky Enterprises' credit risk. This is determined as follows:

$$POD \times LGD = 0.03 \times 0.75 = 2.25\%$$

Credit Spread > POD × LGD. Thus, the investor would anticipate being more than adequately compensated for bearing ClearSky's credit risk.



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## Question

For a sovereign or public entity, which of the following is most likely a primary source of repayment?

A. Business operations
B. Corporate and personal taxes8
C. Asset sales

The correct answer is **B.**

Sovereign or public entities primarily derive their repayment from corporate and personal taxes.

**A is incorrect.** Business operations are a primary source of repayment for corporations, not sovereign entities.

**C is incorrect.** Asset sales are a secondary source of repayment for corporations, not a primary source for sovereign entities.



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## LOS 14b: describe the uses of ratings from credit rating agencies and their limitations.

### Credit Rating Agencies Overview

Major credit rating agencies like Moody’s, Standard & Poor’s, and Fitch Ratings critically influence credit markets. They evaluate issuer credit risk using quantitative and qualitative methods, resulting in credit ratings for most corporate and sovereign bonds.

## Credit Ratings Defined

Ratings by major agencies evaluate default risk and potential investor loss. Triple-A rated bonds (Aaa or AAA) signify high quality and low risk. Bonds rated Baa3/BBB– or higher are "investment grade", denoting stability. Conversely, bonds rated lower, like Ba1 or BB+, signify higher default risks, often labeled "junk bonds” or "high yield" bonds. D rating signifies default in S&P's and Fitch's scales.

## Rating Process

Agencies, when assigning ratings, may access non-public information from issuers. Post-issuance, agencies monitor issuer performance, adjusting ratings based on perceived credit risk changes. They might also issue outlooks reflecting potential future creditworthiness shifts.

## Importance of Credit Ratings

Investors often utilize these ratings for easy comparison of creditworthiness across bond issuers. These ratings can indicate shifts in market conditions and potentially activate contractual clauses. They also cater to regulatory, statutory, and contractual requirements.

## Considerations for Investors

While ratings offer valuable insights, sole reliance can be risky. Market pricing of credit risk can outpace rating adjustments. Furthermore, certain risks might be overlooked in ratings. Additionally, unforeseen changes or miscalculations can sometimes skew a rating's accuracy. Hence, investors should merge rating insights with their analysis, especially when considering high-risk bonds.



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## Limitations & Criticisms

Rating agencies have faced backlash for overlooking significant financial risks, notably during the 2008–2009 Global Financial Crisis. Consequently, regulations were enhanced to promote transparency and reduce conflicts of interest. While new rating agencies have emerged, the dominance of major agencies remains unchallenged.



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## Question

Bonds that are rated Baa3/BBB– or higher are best classified as:

A. Junk bonds.
B. Investment grade.
C. Non-investment grade.

The correct answer is **B.**

Bonds rated Baa3/BBB– or higher are referred to as "investment grade," indicating a level of stability and lower credit risk.

**A is incorrect:** Junk bonds are typically those with ratings lower than Baa3/BBB–, signaling higher default risks.

**C is incorrect:** While "non-investment grade" is another term for junk bonds, Baa3/BBB– or higher-rated bonds are considered investment grade.



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### LOS 14c: describe macroeconomic, market, and issuer-specific factors that influence the level and volatility of yield spreads.

Corporate bonds and other debt with higher credit risk typically have higher yields compared to default-free bonds like US Treasuries. These yield differences, measured in basis points, can widen due to factors such as declining creditworthiness (credit migration or downgrade risk) or market-related issues like increased risk aversion during financial distress. Credit spread risk refers to the potential for greater expected losses due to changes in credit conditions influenced by macroeconomic, market, and issuer-specific factors.

## Macroeconomic Factors

Economic conditions and credit cycles are closely tied. When the economy thrives, credit spreads (the interest rate differences based on credit quality) shrink, indicating investors are okay with more risk. Conversely, in a downturn, spreads widen.

High-yield (HY) bonds, which are riskier, offer several benefits:

1. Portfolio Diversification: HY bonds have a lower correlation relative to investment-grade (IG) bonds and government bonds. So, adding them to a portfolio can provide more variety and potentially better returns for the risk taken.
2. Capital Appreciation: When the economy gets better or a company issuing the bond performs well, the price of HY bonds can rise more than IG bonds. This can be due to better financial performance, mergers, or positive changes in company management.
3. Stable Returns: Even though HY bond prices move similarly to stock prices, they usually provide steadier returns. This is because they have a bigger interest component. Some studies even suggest HY bonds can give better returns than stocks over a long period, especially for those who do not like the volatility of stocks.

Bonds with higher credit ratings exhibit lower yields for given maturities due to their perceived higher level of security. Conversely, bonds with longer durations typically offer higher yields as a result of increased default risks. The difference in yields between (IG) bonds is comparatively



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narrower when compared to the difference between IG and HY bonds. During periods of economic volatility, HY bonds are prone to changes in spreads, particularly when investors place greater emphasis on safer assets, a phenomenon commonly referred to as "flight to quality." Moreover, HY bonds may encounter selling difficulties during periods of economic downturn.

## Market Factors

Highly liquid bonds, e.g., sovereign debt from developed countries, have yields that combine real interest rates and an expected inflation premium. On the other hand, corporate bond yields add extra premiums for credit and liquidity risks, as well as potential tax consequences. Market liquidity risk pertains to the costs and uncertainties associated with trading bonds, especially concerning the differences between stated and actual transaction prices. Two key factors tied to issuers, namely the amount of their publicly traded debt and their creditworthiness, influence this liquidity risk. Bonds that trade frequently and in large volumes have reduced liquidity risks. During financial crises, market liquidity can decrease significantly, affecting bond prices and yield spreads across various debt types.

## Issuer-Specific Factors

Issuer-specific factors are those unique to an individual bond issuer, impacting how their bonds are priced and how volatile those prices might be. Debt coverage and leverage are factors common to all issuers. Debt coverage indicates how easily a borrower can cover its debt obligations using its cash flows. A high debt coverage ratio suggests the issuer has a strong financial position, reducing the risk for bondholders. On the other hand, leverage represents how much debt a company has in relation to its equity or other financing sources. A high leverage can indicate higher risk, as the issuer is more dependent on debt financing.

### Repayment and Investment Dynamics

Corporate issuers borrow money to invest in long-term assets that drive profits, like machinery or new facilities. They repay debt from the money they make in their operations. On the other hand,



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sovereign entities borrow to finance public services and infrastructure. They repay from revenues mainly collected from taxes.

## Investor Evaluation Techniques

When assessing the yield and yield spread of a specific issuer's bond, investors can use the following comparisons:

- Credit Rating: Bonds with the same rating have similar default risks.
- Sector: Companies in the same industry often face similar risks and opportunities.
- Business Model or Features: For example, tech companies might be compared together even if they offer different products.



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## Question

What is most likely to happen to credit spreads during economic downturns?

A. Credit spreads will remain constant.
B. Credit spreads will narrow.
C. Credit spreads will widen.

The correct answer is **C.**

During economic downturns, investors become more risk-averse, leading to widening credit spreads as the perceived risk of corporate bonds increases relative to default-free bonds.

**A is incorrect:** Economic downturns typically do impact credit spreads.

**B is incorrect:** Credit spreads are more likely to narrow during economic upturns, not downturns.



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# Learning Module 15: Credit Analysis for Government Issuers

## LOS 15a: explain special considerations when evaluating the credit of sovereign and non-sovereign government debt issuers and issues.

Sovereign and non-sovereign entities use debt issuance to finance their operations. In contrast to corporate bonds, these debts are utilized for fiscal projects and to meet budgetary needs. These needs may encompass essential public services such as transportation infrastructure, healthcare facilities, and educational institutions. One example is the issuance of Treasury bonds by the US government.

## Sovereign Credit Analysis

Sovereign debt is commonly repaid through various sources of state income, such as taxes, fees, tariffs, and profits generated by state-operated businesses. The primary factor contributing to the relatively low credit risk associated with bonds issued by sovereign entities within a nation is the inherent power of these entities to impose taxes on the private economic activities carried out within their territory. However, it is widely acknowledged that bonds issued by major economies such as the United States or Germany are typically perceived as having minimal default risk. Conversely, bonds from developing economies such as Argentina or Nigeria bear a higher risk of default.

### Criteria for Assessing Creditworthiness

The assessment of creditworthiness, whether for corporations or governments, is based on multiple factors. Bond investors evaluate the stability of cash flows, the sufficiency of these flows to meet interest and principal obligations, and the extent to which the issuer relies on debt financing in comparison to alternative sources of funding. Evaluating the creditworthiness of sovereigns or other government borrowers includes a combination of qualitative and quantitative elements unique to the public sector.

### Qualitative Factors in Sovereign Creditworthiness



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## Government Institutions & Policy

Government institutions and policies are vital in maintaining a nation's political and economic stability. These policies cover essential legal aspects such as upholding the rule of law and ensuring transparent financial reporting. Harmonious relations with neighboring countries also gauge political stability. Often, these factors are assessed using a ranking system.

Furthermore, besides a country's ability to repay debts, its commitment to do so is crucial, especially for sovereign issuers. This is due to the principle of sovereign immunity, which prevents bondholders from forcing a sovereign government into bankruptcy. As a result, many investors, in collaboration with entities like the IMF, choose to restructure debts to safeguard their investments.

## Fiscal Flexibility

It involves evaluating a government's ability to maintain fiscal discipline across varying economic conditions. Various factors that contribute to the overall economic performance of a nation include the efficiency of tax collection, prudent allocation of budget for public goods, and management of sovereign debt relative to the country's economic activity. Past fiscal behavior and anticipated effects of future fiscal policy changes are considered.

## Monetary Effectiveness

Monetary effectiveness pertains to the actions undertaken by a nation's central bank to control the money supply and credit availability. The activities assessed within this domain include determining interest rates, setting reserve requirements, and buying/selling sovereign bonds. The central bank's independence from the government is crucial as it can determine if the country will monetize its debt, which could result in increased inflation and decreased currency value.

## Economic Flexibility

Economic flexibility pertains to the assessment of economic activities conducted within the territorial boundaries of a country, intending to utilize them for repaying debts. The size of the economy, per capita income, economic diversification, and growth potential are critical. High-rated



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sovereigns usually have diversified and growth-oriented economies. Conversely, emerging or frontier economies may depend on a single industry or commodity, making them vulnerable to economic downturns, price changes, or trade disruptions.

## External Status

External status refers to how a country's international trade and financial policies affect its ability to manage and service its debt. The credibility of monetary policy and the type of exchange rate regime can influence international capital inflows. Sovereign governments with a widely accepted and traded currency (reserve currency) can more easily access foreign investors with domestic currency debt, reducing the risk of default.

## Quantitative Factors in Sovereign Creditworthiness

Quantitative credit analysis estimates how likely a country will meet its debt obligations. Sovereign credit analysts face challenges because they rely on government data that can differ in quality and comparability and may be revised due to political considerations. Consequently, analysts use a macroeconomic approach, emphasizing quantitative factors. Financial ratios help compare sovereign issuers similarly to corporate issuers. Instead of using total sales or assets as in corporations, sovereign ratios use government revenue or GDP to measure economic activity subject to taxation.

## Fiscal Strength

Fiscal strength indicates a sovereign’s capability to manage its debt. The factors considered here include the current and future debt burden and reliance on debt vs. other resources. Debt burden indicators resemble corporate leverage metrics, with a higher debt ratio implying lower credit quality. Annual fiscal surpluses/deficits as a percentage of GDP assess fiscal discipline and whether a country's debt burden is improving.

## Economic Growth and Stability

Bigger, wealthier economies can better achieve sustainable growth and resist shocks. Important



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factors considered when measuring economic growth and stability include the economy's size (GDP), per capita income, historical and projected economic growth levels, and variability of these growth levels.

### External Stability

This relates to the confidence of foreign investors in holding a country's currency assets. Non-reserve currency countries' ability to meet external debt obligations is assessed by the external liquidity (short-term ability) and external solvency (long-term ability) to generate stable foreign currency inflows to cover external debt and other obligations. Measures of external stability involve comparing external debt to sources of repayment, such as GDP, foreign currency balances, or cash flows. A nation's current account deficits/surpluses, determined by the international trade of goods and services, impact its capital account due to foreign capital inflows/outflows.

### Role of External Factors

1. For emerging nations, commodity exports may dominate foreign currency reserves.
2. Demand and prices for these commodities can heavily influence sovereign creditworthiness.
3. Nations with consistent demand, like oil producers, often have large reserves and may establish sovereign wealth funds. However, fluctuations in commodity prices can threaten their financial stability.

## Non-Sovereign Credit Risk

Non-sovereign government issuers, such as government agencies or regional governments, issue debt to finance activities. Investors typically face a credit risk similar to sovereign issuers due to either implicit or explicit government backing. Explicit government backing is a government official guarantee or promise to back the obligations (like debts) of a non-sovereign entity. On the other hand, Implicit government backing is an assumed or informal belief that the government will step in to support a non-sovereign entity's obligations if required, even though there's no formal guarantee in place. Debt with implicit backing is perceived as riskier than those with explicit backing since the



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government has no legal obligation to intervene.

Regional government issuers have their own taxation and income-generating powers but may vary in creditworthiness from the sovereign issuer.

## Main Types of Non-Sovereign Government Issuers

### Agencies

These are quasi-government entities fulfilling government missions, often authorized to finance their activities using debt. For example, the Airport Authority Hong Kong SAR (AAHK) issued perpetual bonds following a decrease in passenger volume during the COVID-19 pandemic.

### Government Sector Banks and Development Financing Institutions

Institutions sponsored by sovereign governments to promote specific objectives. For example, Kreditanstalt für Wiederaufbau (KfW) is Germany's largest national development bank, 80% owned by the government. It receives an explicit and formal guarantee and institutional responsibility from the Federal Republic of Germany.

### Supranational Issuers

Entities established by sovereign governments to pursue common objectives. Examples include the World Bank, the Asian Development Bank, and Indonesia Infrastructure Finance (IIF).

### Regional Government Issuers

Provincial, state, and local governments issue bonds within a sovereign jurisdiction, known as municipal bonds in the US.

## Types of Bonds Issued by Non-Sovereign Governments

### General Obligation (GO) Bonds



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General Obligation (GO) bonds are debts issued by non-sovereign governments and are not backed by any specific collateral. Instead, they rely on the general revenues and the ability of the issuing entity to levy and collect taxes. The creditworthiness of these bonds is influenced by factors such as the health of the local business environment, the strength of major industries, potential support from the national government, and effective budget management. However, unlike sovereign entities, non-sovereign issuers have limited powers and cannot control major economic institutions. They might also be more susceptible to technological and demographic shifts.

## Revenue Bonds

Revenue bonds are riskier than GO bonds as they finance specific projects relying on a single revenue source. Their analysis resembles that of corporate bonds, focusing on the project's viability and financial metrics like the debt service coverage ratio, which measures the available revenue to cover debt costs. A higher ratio indicates better creditworthiness. The stability of cash flows is essential when evaluating these bonds. Besides the usual revenue sources like taxes and fees, other repayment means are crucial, especially for bonds from entities like airport authorities or public utilities. Sometimes, a national government might step in for repayment if revenues are insufficient.



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## Question

The principle that is *most likely* to prevent bondholders from forcing a sovereign government into bankruptcy is the principle:

A. sovereign priority.
B. sovereign immunity.
C. sovereign obligation.

The correct answer is **B.**

Based on the principle of sovereign immunity, domestic regulations restrict investors from pushing a sovereign government into bankruptcy or selling off its assets to address debt claims, unlike the procedures followed for corporate issuers.

**A is incorrect:** There is no "principle of sovereign priority."

**C is incorrect:** While "sovereign obligation" might sound relevant, it's the principle of sovereign immunity that specifically addresses the inability to force a sovereign government into bankruptcy.



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# Learning Module 16: Credit Analysis for Corporate Issuers

## LOS 16a: describe the qualitative and quantitative factors used to evaluate a corporate borrower’s creditworthiness.

## Creditworthiness of a Company

The creditworthiness of a company is primarily determined by its ability to generate profits and cash flow that are sufficient to meet its interest and principal payments. This is a crucial aspect of a company's financial health and stability, and it is closely monitored by analysts and investors alike. For instance, a company like Apple Inc., with a strong cash flow and high profitability, is considered to have high creditworthiness.

## Corporate Default

Analysts use a combination of qualitative and quantitative factors to assess the likelihood of a corporate default. A corporate default occurs when a company is unable to meet its financial obligations, such as paying interest or repaying the principal on its debt. The risk of corporate default is a key concern for investors, as it can result in significant financial losses. For example, the default of Lehman Brothers in 2008 led to massive losses for its investors and triggered a global financial crisis.

## Qualitative and Quantitative Factors in Credit Risk Analysis

### Qualitative Factors in Evaluating Corporate Borrowers' Creditworthiness

The ability of a company to satisfy its debt obligations is gauged by several key qualitative factors. These include the company's business model, the industry it operates in, and the competitive forces and business risks it faces. For instance, a company like Amazon, with a diverse business model and a dominant position in the e-commerce industry, is likely to have a higher capacity to use debt in their



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capital structure and a lower likelihood of default compared to a small retail business with a single line of business and high competition. Qualitative factors are discussed in more detail below.

1. Corporate Governance:

i. Use of Proceeds & Treatment of Debtholders: Companies must transparently communicate how they intend to use the borrowed funds. If funds are directed towards growth or improving operational efficiency, it signifies a positive intention. Equally important is the company's history of treating its debtholders, which can provide insights into its ethical standards and reliability.
ii. Legal, Tax, and Accounting: Adherence to legal regulations, punctual tax payments, and adoption of universally accepted accounting practices reflect a company's commitment to ethical operations. Any deviations or legal disputes can be red flags for potential debtholders.
iii. Covenant Compliance: Consistent compliance with loan covenants indicates the borrower's respect for contractual obligations and its intent to maintain a positive relationship with lenders.

2. Industry and Competition:

i. Structure & Concentration: A dominant position in the industry or a less crowded market can mean reduced competitive pressures, potentially leading to stable revenues.
ii. Competitive Forces: Companies in hyper-competitive industries may face challenges like price wars, which can erode profit margins and impact their ability to service debt.
iii. Long-Term Growth & Demand: Industries with a positive growth trajectory offer better opportunities for companies to expand, improving their revenue streams and ability to meet financial obligations.

3. Business Risk

Business risk refers to the potential for adverse outcomes or uncertainties that may impact the operations, profitability, or overall success of a business. It encompasses various factors such as market volatility. Companies that frequently fail to meet their projected financial outcomes may be perceived as exhibiting unpredictability, hence creating challenges for lenders in placing confidence in their future projections.



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4. Business Model:

i. Demand/Revenue/Margin: A consistent demand for products/services, steady revenue streams, and healthy profit margins are indicators of a robust business model. This consistency assures lenders of the company's ability to generate enough revenue to meet its debt obligations.
ii. Stability and Predictability: A business model that demonstrates resilience, especially during economic downturns, is more attractive to lenders.
iii. Asset Quality: High-quality assets can be liquidated easily if needed, providing an additional layer of security for lenders.

5. Issuer-Specific Factors:

i. Demand/Revenue/Margin: Factors specific to the issuer, such as its market reputation, client relationships, and unique selling points, can influence its revenue patterns.
ii. Stability and Predictability: Issuers with a history of stable operations and predictable cash flows are more likely to be trusted by lenders.

6. Industry-Specific Factors:

Cyclicality, intra-industry rivalry, and life cycle are important factors to consider when analyzing companies in different stages of industry development. Mature industries often experience slower growth rates due to their established market positions. On the other hand, companies operating in developing industries may encounter higher growth rates but also confront greater unpredictability.

7. External Factors:

i. Macroeconomy & Technology: Economic downturns or rapid technological changes can disrupt operations. Companies that can adapt and innovate are better positioned to navigate these challenges.
ii. Demographic, Government, Geopolitics, & ESG: Changes in population dynamics, governmental policies, geopolitical tensions, and ESG considerations can significantly impact a company's operations. Companies that proactively address these challenges demonstrate foresight and resilience.



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## Qualitative Factors in Evaluating Corporate Creditworthiness

Financial statement analysis and projections offer a numerical representation of an analyst's expectations for a firm's outcomes. Insights into the company's core operational factors and anticipated challenges and prospects guide the formulation of these models. These insights are gathered either through a broader, macroeconomic viewpoint or a more granular, company-focused approach. In contrast to equity models, which determine stock value based on all available cash flows to shareholders, quantitative credit assessment calculates a firm's ability to handle future debt.

A top-down review starts by considering the economic trends, comparing a company's growth to the GDP, understanding its potential market size, its position within that market, and evaluating potential negative events via scenario analysis. Given that economic phases influence when and how credit cycles happen, the expected effects of these credit cycles on a company or sector often serve as a barometer for broad-scale credit risk. Integrating anticipated economic trends with specific company factors can help forecast cash flows. Conversely, a bottom-up approach zeroes in on primary sources of income and key items on the balance sheet. The aim of quantitative research is to pinpoint what influences a company's likelihood of default (POD) and track its evolution over various credit cycles. Qualitative factors include;

1. Macro (Top-Down) Approach:
    - Macroeconomy:

    i. GDP growth: This reflects the economic health of the country or region where the company operates. A rising GDP often suggests a thriving economy, which can be beneficial for businesses.
    ii. Cyclicality: Businesses often face ups and downs based on economic cycles. Understanding where a company stands in these cycles can provide insights into its future performance.

    - Industry:

    i. Addressable Market: It's essential to know the total potential market the company can cater to. A larger addressable market often means more opportunities for growth.



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ii. Market share: The company's share in its market can indicate its competitiveness and dominance. A higher market share often equates to better business stability.

- Event risk:

i. Scenario analysis: Anticipating various future scenarios (both positive and negative) helps in understanding how external factors might affect the company.
ii. External shocks: Unpredictable events, like geopolitical issues or natural disasters, can impact a company's performance. A company's preparedness and resilience to such shocks can be a critical factor in its creditworthiness.

2. Issuer-Specific (Bottom-Up) Approach:

- Balance sheet:

i. Liquidity: A company's ability to quickly convert its assets into cash to meet short-term obligations is crucial. High liquidity often suggests that a company can comfortably cover its immediate liabilities.
ii. Leverage: This measures the company's dependence on borrowed funds. High leverage can indicate higher risk, as it means the company has significant debt compared to its equity.
iii. Profitability: The company's margin and return on assets or equity can provide insights into its operational efficiency and its ability to generate returns.

- Income statement:

i. Revenue growth: A steady increase in sales suggests that the company is growing and can potentially expand further.
ii. Operating profit: This is a clear indicator of how well a company's core business operations are performing, excluding any one-off items or financial activities.

- Cash flow statement:

i. Debt service coverage: The ratio of operating income to total debt service. It helps determine if the company generates enough income to cover its debt obligations.
ii. Interest coverage: This measures the company's ability to pay interest on its outstanding debt. Higher values indicate more earnings available to cover interest expenses, suggesting lower credit risk.



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## Question

When evaluating the creditworthiness of a company in a mature industry, which of the following is most likely a potential challenge lenders should consider?

A. The company will likely experience higher growth rates due to its established market position.
B. The company may face greater unpredictability in its operations.
C. The company may encounter slower growth rates due to the established nature of the industry.

The correct answer is **C.**

Mature industries often experience slower growth rates because of their established market positions.

**A and B are incorrect:** Companies in mature industries are less likely to experience higher growth rates and typically face less unpredictability than those in developing industries.



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## LOS 16b: calculate and interpret financial ratios used in credit analysis.

Financial ratios derived from quantitative factors enable credit analysts to gauge a company's financial health, spot trends, and conduct comparisons within and across sectors. The focus is primarily on three critical areas: profitability, coverage, and leverage.

# Profitability Ratios

### EBIT Margin

It assesses a company’s operational efficiency before considering capital costs and taxes.

$$\text{EBIT Margin} = \frac{\text{Operating Income}}{\text{Revenue}}$$

A high EBIT margin suggests that a larger portion of sales revenue remains after paying for variable costs of production, indicating good profitability.

# Coverage Ratios

### EBIT to Interest Expense

This metric measures a company's ability to cover its interest obligations using its operating profit.

$$\text{EBIT to Interest Expense} = \frac{\text{Operating Income}}{\text{Interest Expense}}$$

A higher value suggests that the company can easily meet its interest obligations from its operating profit, indicating lower credit risk.

# Leverage Ratios



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### Debt to EBITDA

It evaluates the company's leverage by comparing its total debt to its overall operating performance.

$$\text{Debt to EBITDA} = \frac{\text{Debt}}{\text{EBITDA}}$$

A higher Debt to EBITDA is a red flag, indicating a higher degree of financial risk.

### RCF to Net Debt

Assesses leverage by comparing cash retained in the business to net debt.

$$\text{RCF to Net Debt} = \frac{\text{Retained Cash Flow (RCF)}}{\text{Debt} - \text{Cash and Marketable Securities}}$$

A higher RCF to Net Debt suggests the firm has retained more cash relative to its net debt, pointing toward better financial stability.

## Cash Flow Measures

Cash flow measures such as Free Cash Flow (FCF), Funds From Operations (FFO), and Retained Cash Flow (RCF) are often used in credit analysis. They emphasize cash flows from operations over those from asset sales or financing. Some cash flow measures Include:

1. Free Cash Flow (FCF): Net income minus necessary investments in working capital and fixed assets and net interest paid.
2. Funds from Operations (FFO): Net income with added back non-cash expenses.
3. Retained Cash Flow (RCF): Operational cash flow minus dividends.

These measures are conservative because they adjust for cash used in core business activities or distributed to shareholders.

## Additional Considerations



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Debt and interest measures might undergo adjustments to account for operational leases or other fixed commitments, not on the balance sheet. The concepts and definitions provided for these ratios are among several usages and may not have official IFRS definitions.

## Example: Credit Analysis

A credit analyst is evaluating the financial health of AlphaTech Inc. The company's financials are given in the following table:

| Metric | Amount ($ in millions) |
|---|---|
| Operating Income (EBIT) | 50 |
| Revenue | 200 |
| Interest Expense | 10 |
| Total Debt | 150 |
| EBITDA | 70 |
| Cash and Marketable Securities | 30 |
| Dividends | 5 |

**Profitability Ratios**

$$\text{EBIT Margin} = \frac{\text{Operating Income}}{\text{Revenue}} = \frac{50}{200} = 0.25 \text{ or } 25\%$$

With an EBIT Margin of 25%, AlphaTech Inc. retains $0.25 for every dollar of revenue after covering variable production costs. This is a strong profitability indicator.

**Coverage Ratios**

$$\text{EBIT to Interest Expense} = \frac{\text{Operating Income}}{\text{Interest Expense}} = \frac{50}{10} = 5$$

An EBIT to Interest Expense ratio of 5 indicates that AlphaTech can cover its interest expense 5 times over with its operating profit, implying lower credit risk.

**Leverage Ratios**

Debt to EBITDA:

$$\text{Debt to EBITDA} = \frac{\text{Debt}}{\text{EBITDA}} = \frac{150}{70} = 2.14$$



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The Debt to EBITDA ratio of 2.14 suggests that AlphaTech's debt is slightly over twice its operational performance. A higher value here would be concerning.

RCF to Net Debt:

RCF (Net cash from operations - Dividends) $= 50 - 5 = 45$

Net Debt = Debt - Cash and Marketable Securities $= 150 - 30 = 120$

$$\text{RCF to Net Debt} = \frac{\text{RCF}}{\text{Net Debt}} = \frac{45}{120} = 0.375 \text{ or } 37.5\%$$

The RCF to Net Debt ratio of 37.5% indicates that the company retains cash, equating to 37.5% of its net debt, which is a positive sign of financial stability.



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## Question

Company A and Company B operate in the same industry.

| | Company A | Company B |
|---|---|---|
| EBITDA margin | 20% | 18% |
| FCF | (−15) | 10 |
| FCF before dividends | (−10) | 5 |
| Debt/EBITDA | 3.0 | 2.0 |
| EBITDA/interest expense | 2.5 | 3.0 |

Based on the financial information above, which of the following statements Is most likely correct?

A. Company A has a lower credit risk than Company B.
B. Company B has a lower credit risk than Company A.
C. Both companies have the same credit risk.

The correct answer is **B.**

1. EBITDA margin: Company A has a higher EBITDA margin (20% vs. 18%), suggesting it is more profitable.
2. FCF: Company B has a positive FCF of 10, while Company A has a negative FCF of (15). This indicates that Company B is in a better cash flow position.
3. FCF before dividends: Company B also has a better position here with 5 compared to Company A's (10).
4. Debt/EBITDA: Company B has a lower Debt/EBITDA ratio (2.0 vs. 3.0), suggesting it is less leveraged and, therefore, potentially less risky.
5. EBITDA/interest expense: Company B has a higher EBITDA/interest expense ratio (3.0 vs. 2.5), meaning it is better positioned to cover its interest expenses with its earnings.

Based on the evaluation: Company A has a higher EBITDA margin, but this advantage is



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offset by its negative FCF, higher leverage, and lower interest coverage. Company B has positive FCF, better FCF before dividends, lower leverage, and better interest coverage.



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## LOS 16c: describe the seniority rankings of debt, secured versus unsecured debt and the priority of claims in bankruptcy, and their impact on credit ratings.

Debt seniority is the system that determines the priority of payment when a company defaults. Debt obligations vary in seniority. Some companies have simple capital structures, while others, especially those in industries impacted by regulations or acquisitions, have complex debt structures.

# Seniority Rankings of Debt

### Secured vs. Unsecured Debt:

Secured debt Is a type of debt that has collateral (e.g., real estate, machinery) backing it. In case of a default, lenders can seize the collateral to recover their money. An example would be a mortgage, where a house serves as collateral. On the other hand, lenders of unsecured debt provide funds without any specific asset as collateral. Credit cards are common unsecured debts. Debt with a higher seniority ranking often has better credit ratings due to its priority in repayment and the security it offers to lenders.

### Hierarchy of Seniority:

i. First Mortgage and First Lien: These are top of the pile when it comes to debt repayment. They have the first claim on assets in case of a default.
ii. Second Lien: Ranking just below the first lien, it has a secondary claim on the collateral.
iii. Senior Unsecured Debt: Without specific collateral but ranks higher than other unsecured debts.
iv. Subordinated Debt and Junior Subordinated Debt: These are at the bottom of the ranking. They will only be repaid once all other debt obligations are satisfied.

### Priority of Claims in Bankruptcy

When a company goes bankrupt, there's a legal pecking order regarding who gets paid back first:



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i. Secured Creditors: These lenders have the first dip into the company's assets. If a company pledged specific assets like property or equipment to secure a loan, the lender could seize and liquidate these assets to recover its money.
ii. Unsecured Creditors: Once secured creditors are paid, unsecured creditors, like bondholders or suppliers who provided goods on credit, are next in line.
iii. Shareholders: These stakeholders are last in line. Common shareholders will only receive money if there are any leftover funds after all the creditors have been paid. Often, they end up with nothing.

Bankruptcy can reduce a company's value due to associated costs, like legal fees, and operational challenges, like the loss of key personnel.

## Recovery Rates

Recovery rates indicate the portion of the debt that might be recovered in a bankruptcy scenario.

Factors Affecting Recovery Rates:

i. Seniority Ranking: Senior debts usually have higher recovery rates.
ii. Industry & Economy: Industries in decline tend to have lower recovery rates. Strong economies lead to higher recovery rates due to better resale value of collateral.
iii. Debt Composition: An abundance of secured debt might reduce the recovery rate for lower-ranked debt.

## Bankruptcy Implications

The legal standard prioritizes the highest-ranked creditors first. However, to expedite the bankruptcy process, lower seniority creditors and shareholders might receive payments. Bankruptcy can also erode company value due to legal fees, loss of key personnel, and market share reduction. Finally, bankruptcy laws and outcomes differ across countries, influencing creditor outcomes in default scenarios.



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## Issuer vs. Issue Ratings

Credit rating agencies often differentiate between a company's overall creditworthiness (issuer rating) and the creditworthiness of a specific debt issue (issue rating). While the issuer rating might look at the big picture, the issue rating would consider specifics like seniority. The probability of default might be the same for an issuer and its issues. However, ratings can differ due to differences in loss-given default (LGD) stemming from factors like seniority.

Notching is a rating adjustment methodology that considers differences in loss severity. Structural subordination arises when a corporation with a holding company structure has debts at both its parent holding company and operating subsidiaries.

## Role of Seniority

The seniority of a debt instrument can influence its credit rating. Senior debts are often seen as less risky and might get a higher rating compared to subordinated debts.

**Rating Agencies' Approaches**

i. Moody's focuses on both the probability of default and the expected financial loss, with their ratings primarily reflecting the expected loss.
ii. Standard & Poor's (S&P) leans more towards the probability of default in its credit ratings. They issue separate recovery ratings to indicate relative seniority and expected loss.
iii. Fitch aligns more with S&P, offering Issuer Default Ratings reflecting a probability of default view, and making rating adjustments based on expected recoveries for specific issues.



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## Question

Which of the following debt types Is most likely to have the lowest priority in the event of a company bankruptcy?

A. First Mortgage
B. Senior Unsecured Debt
C. Subordinated Debt

**The correct answer is C:**

Subordinated Debt is at the bottom of the seniority rankings and will only be repaid once all other debt obligations are satisfied.

**A is incorrect:** First Mortgage is at the top of the debt repayment hierarchy.

**B is incorrect:** Senior Unsecured Debt, while it doesn't have specific collateral, still ranks higher than Subordinated Debt.



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# Learning Module 17: Fixed Income Securitization

## LOS 17a: explain benefits of securitization for issuers, investors, economies, and financial markets

Securitization is a method that encompasses the pooling and transferring of the ownership of assets that generate cash flow, such as loans or receivables, to a special legal entity. This entity then offers securities, which are underpinned by these assets, to investors. For instance, a bank that has issued multiple home loans can pool these loans together and sell them to a Special Purpose Entity (SPE). The collection of assets is termed as securitized assets, often known as the reference portfolio or collateral. This distinct legal structure then releases securities to investors, which are backed by the pooled assets. The resultant cash flows are employed to cover interest and return the principal to these investors. Securitization establishes a direct connection between investors and borrowers for various loan types and receivables, yielding advantages for issuers, investors, economic systems, and financial marketplaces.

## Types of Asset-Backed Securities (ABS)

### Covered Bonds

Predominantly used by European banks, these involve designating a specific mortgage loan pool on the bank's ledger, distinct from other assets. For instance, Deutsche Bank might release bonds supported by home loan pools. If there is a default, investors can leverage the collateral for repayment. These bonds do not fully qualify as securitizations since they remain on the bank's balance sheet and payments come directly from the bank, not the loan pool's cash flow.

### Pass-through Securities

These embody true securitizations. A distinct legal entity receives assets, removed from the original balance sheet, and issues securities supported by these assets. As an example, a bank might transfer auto loans to an entity which then issues securities to investors. Payments from the asset pool are proportionally distributed across various risk levels.



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### Bonds with Structural Enhancements

These securities aim to make payment patterns more consistent by channeling cash flows across predetermined tranches. They use tools like set payment schedules and tranching to cushion against unforeseen payment changes. Additionally, they might incorporate credit enhancements, such as reserve funds or overcollateralization, to further minimize risk.

### Mortgage-backed Securities (MBS)

MBS are ABS sustained by mortgage pools. They are distinct from ABS backed by non-mortgage assets. Tranching determines payment sequences and how losses are managed. For instance, an MBS by Freddie Mac might prioritize a senior tranche for payments and lastly for absorbing losses, while a junior tranche would be the opposite.

## Advantages of Securitization for Issuers

- Through securitization, banks can enhance their profitability. They achieve this by collecting origination charges and lessening capital obligations for loans traded to investors. By distinguishing between the initiation of a loan and its financing, banks can optimize efficiency considering risk.
- By offloading illiquid assets via securitization, banks can offload assets and the associated risks, resulting in superior risk oversight and better capital ratios in line with regulations.
- Securitization permits banks to exceed their balance sheet constraints when originating loans. This capability means they can offer more loans, which can invigorate economic progress.

## Advantages for Investors

- Securitization offers investors a chance to invest in securities funded by loans or receivables without directly managing those assets. This opens the door for a wider



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investor base to access private-sector debt.

- Investors can customize their risk and return perspectives by choosing from different tranches or categories of securities, each with its credit risk level. Such flexibility promotes portfolio diversification and aligns with specific investor preferences.
- Investing in securitized debt might yield greater returns compared to investing in traditional bonds, all the while maintaining a high credit rating.

## Advantages for Economic and Market Structures

- Securitization produces tradable securities that augment market liquidity. The feasibility of trading these assets in secondary markets aids investors in pinpointing balanced pricing, which in turn, boosts market efficacy.
- Securitization serves as an alternative financing mechanism for businesses, sidestepping conventional methods like bonds or equity. By consolidating assets eligible for securitization, firms can lower financing expenditures and realize superior capital returns than traditional borrowing avenues.
- Direct market access becomes possible for companies through securitization, eliminating the need for extra debt generation. This approach can sustain or elevate their creditworthiness whilst tapping into more cost-effective capital sources.
- The overarching system gains from securitization. It's beneficial for producers, consumers, and investors by allowing producers to delegate debt management, cutting down expenses for consumers, and presenting a variety of investment opportunities to investors.



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## Question

Which of the following *best* describes the purpose of a Special Purpose Entity (SPE) in securitization?

A. To offer loans directly to borrowers.
B. To issue securities backed by pooled assets to investors.
C. To act as an intermediary between banks and borrowers.

**Solution**

The correct answer is **B.**

A Special Purpose Entity (SPE) receives pooled assets and issues securities supported by these assets to investors.

**A is incorrect:** An SPE does not directly offer loans; it handles the pooled assets.

**C is incorrect:** The SPE does not act as an intermediary but as a distinct legal structure that holds the pooled assets.



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### LOS 17b: describe securitization, including the parties and the roles they play

Securitization is the financial practice of pooling various types of contractual debt like auto loans and selling their related cash flows to third party investors as securities, which are typically characteristic of a blend of both bonds and stocks. It increases the liquidity of these assets and frees up capital for the original lender to finance more loans.

## Parties to a Securitization

1. Seller/Originator - Grants loans to customers which are then sold to an SPE as the first step of securitization.
2. Special Purpose Entity or Vehicle (SPE or SPV)- This separate, bankruptcy-remote entity buys the loans and uses them as collateral to issue ABS. The SPE's bankruptcy-remote status acts as a safety measure to ensure that the underlying assets of the securities are protected in case the originator goes bankrupt.
3. Servicer: The servicer is accountable for the administration of the loans, which covers the collection of payments, managing loan defaulters, and the disposal of assets if borrowers default.

Moreover, other important parties can include professionals like accountants, lawyers, trustees, underwriters, rating agencies, and potentially financial guarantors. Trustees safeguard the assets and perform duties as per the terms of the prospectus such as holding funds due to the ABS holders.

In addition to the conventional bond indenture and its associated covenants, there are two other critical legal documents in the securitization process. These documents bear resemblance to those used in an MBS transaction and include:

1. Purchase Agreement - Details the conditions and responsibilities of the seller and the SPE regarding the assets being sold. It provides investors with an assurance about the quality and legitimacy of the underlying assets.
2. Prospectus - Detailing the structure of the securitization, it illustrates the flow of payments



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to different parties and describes any credit enhancements used.

## Role of the SPE

SPEs are instrumental in securitization processes. Their primary function is to legally shield both the issuer and investors in an ABS transaction. A few key roles and characteristics of SPEs include:

1. **Protection from Bankruptcy**: SPEs ensure that securitizations remain unaffected even if the seller of the collateral goes bankrupt. This separation makes raising funds through securitization often more cost-effective than through corporate bonds backed by the same collateral.
2. **Credit Risk Decoupling**: Assets moved to an SPE are isolated from the originating company's credit risk. Consequently, the only credit risk investors face pertains to potential defaults by borrowers within the SPE. As long as these borrowers meet their obligations, the SPE can fulfill its commitments to security holders.
3. **Legal Ownership & Recognition**: In many jurisdictions, securitization is recognized as a true sale. This means the SPE holds complete legal ownership of the securitized assets, which are then removed from the seller's balance sheet. However, there is a caveat: transfers to SPEs could be contested in court as fraudulent transactions, and if deemed so, might be reversed.
4. **Jurisdictional Differences**: Not all countries share identical legal frameworks for SPEs. In regions where trust law is less established, challenges related to ABS issuance might arise. Hence, investors must be aware of and consider the legal nuances of the jurisdictions in which they operate.



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## Question #1

Which document in the securitization process most likely details the conditions and responsibilities of the seller and the SPE concerning the assets being sold?

A. Prospectus
B. Purchase Agreement
C. Bond Indenture

The correct answer is **B.**

The Purchase Agreement lays out the conditions and responsibilities of the seller and the SPE regarding the assets being sold.

**A is incorrect:** The Prospectus details the structure of the securitization.

**C is incorrect:** Bond Indenture is related to bonds and not directly to the assets being sold in securitization.

## Question #2

In the securitization process, which entity is most likely responsible for providing periodic cash flow reports to ABS holders as stipulated in the terms of the prospectus?

A. Seller/Originator
B. Special Purpose Entity (SPE)
C. Trustee or Trustee Agent.

The correct answer is **C.**

The trustee or trustee agent is responsible for providing periodic cash flow reports to ABS holders as agreed upon in the terms of the prospectus.

**A is incorrect:** The Seller/Originator's role is primarily to grant loans and sell them to the SPE.



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**B is incorrect**: While the SPE issues the securities, it does not typically handle the administrative duties associated with the cash flows.



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# Learning Module 18: Asset Backed Security (ABS) Instrument and Market Features

## LOS 18a: describe characteristics and risks of covered bonds and how they differ from other asset-backed securities.

Covered bonds are priority debt instruments, meaning they have a higher claim on the issuing financial institution's assets or income in case of liquidation. These bonds are unique because a separate pool of high-quality assets backs them. Typically, the assets backing these bonds are commercial or residential mortgages or public sector assets, but they can also include other types of assets like ships and commercial aircraft.

## Covered Bond Transaction Process

For covered bonds, the loans remain on the issuer's balance sheet while being segregated or ring-fenced into a separate cover pool. This provides dual recourse for investors. In the event of bankruptcy, investors can claim against the assets in the cover pool and the unencumbered assets of the issuing institution. This ensures a heightened level of security.

The structure typically involves an issuer, usually a bank or financial institution, who creates and is accountable for the repayment of the covered bond. Each covered bond usually features one bond class per dynamic cover pool. The pools are managed by a servicer and overseen by a monitor or trustee. They ensure adherence to performance and underwriting standards and safeguard bondholders' interests. Additionally, they maintain compliance and the performance of the asset pool. Issuers must replace non-performing or prepaid assets to maintain sufficient cash flows until bond maturity.

The evolving landscape is witnessing a rise in green-covered bonds. These bonds are primarily secured by mortgages to environmentally certified green buildings. This trend reflects the growing emphasis on environmental conservation and renewable energy in financial instruments.

## Risk Mitigation



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To mitigate investor risks, covered bonds use strategies like overcollateralization. In this approach, the collateral exceeds the face value of the issued bonds. They also maintain stringent Loan to Value (LTV) ratios on mortgages in the pool, ensuring that only eligible mortgages are included. In events of sponsor default, redemption regimes are structured to maintain the bond's cash flow alignment with the original maturity schedule.

Different mechanisms trigger based on adherence to the payment schedule. With hard-bullet-covered bonds, any variance from the predetermined payment schedule activates a bond default and hastens the bond payments. On the other hand, soft-bullet bonds postpone bond default and the speeding up of bond payments until a revised final maturity date. This date is typically up to a year beyond the initial maturity date. If there are outstanding bond payments after the initial maturity date, conditional pass-through bonds transition to pass-through securities. Finally, if all bond payments are not completed by the original maturity date, conditional pass-through covered bonds transition into pass-through securities.

## Comparison of Asset-Backed Securities (ABS) and Covered Bonds

The following table compares covered bonds and ABS.



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| Feature | Covered Bonds | Asset-Backed Securities (ABS) |
|---|---|---|
| Issuer's Balance Sheet | Loans remain on the issuer's balance sheet. | Loans are removed from the issuer's balance sheet and sold to a separate legal entity. |
| Recourse | Dual recourse: claim on the cover pool and, if insufficient, on the issuer's unencumbered assets. | Recourse only to the assets in the pool; no claim if the pool is insufficient. |
| Risk and Yield | Lower credit risk with lower yields due to added security. | Higher credit risk and can offer higher yields. |
| Asset Management | Assets are managed dynamically with replacement of non-performing assets to maintain cash flows. | Once assets are securitized, not managed dynamically, performance impacts security v |
| Regulation and Oversight | Stringent regulation and oversight to protect bondholders. | Less stringent regulatory requirements vary by jurisdiction and asset type. |
| Market Impact | More stable during market fluctuations due to requirements and dual recourse. | More volatile in fluctuating markets due to direct impact of asset performance. |
| Use of Funds | Used for funding mortgages, public sector loans, and green projects. | Diverse, from credit card receivables to auto loans and student loans. |



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## Question

Which of the following is *most accurate* regarding covered bonds?

A. After the asset pool supporting covered bonds is securitized, it is usually not managed in a dynamic manner.
B. Covered bonds are typically associated with higher credit risk and offer higher yields than similar ABS.
C. Covered bonds often feature overcollateralization, where the collateral underlying the transaction surpasses the face value of the bonds issued.

The correct answer is **C.**

Covered bonds often feature overcollateralization as a strategy to mitigate investor risks, where the collateral underlying the transaction surpasses the bonds' face value.

**A is incorrect:** The assets in covered bonds are managed dynamically, and non-performing assets are typically replaced to maintain sufficient cash flows until bond maturity.

**B is also incorrect:** Covered bonds have lower credit risk and offer lower yields due to the added security and dual recourse nature compared to similar Asset-Backed Securities (ABS).



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## LOS 18b: describe typical credit enhancement structures used in securitizations

ABS inherently carries a high credit risk primarily due to the possibility of underlying borrowers defaulting on their obligations. This can significantly affect the returns for ABS holders. Therefore, structures within ABS are designed to address and mitigate these risks. In a basic securitization procedure, a sole ABS class may be sold. In such cases, certificate holders are allotted a specific share of the returns from the combined assets after deducting any relevant fees. Investors can be vulnerable to the innate risks of the asset pool, like default risk. Many Special Purpose Entities (SPEs) implement various credit enhancement techniques to address these vulnerabilities and protect investor returns, developing complex securitization structures with multiple ABS debt classes.

# Mechanisms of Internal Credit Enhancement

i. **Overcollateralization:** This method ensures that the total value of the assets backing the bond exceeds the bond's issuance value. So, even when some assets default, the extra value from the surplus ensures continued payments to bondholders. For instance, if a bond worth €1,000 million is backed by assets valued at €1,200 million, an extra €200 million acts as a buffer against potential defaults.
ii. **Excess spread:** This is the gap between the interest generated by the collateral and the interest paid out to bondholders. If a loan yields a 9% return, but securities derived from the pool return just 6%, the resulting 3% yield differential can offset potential collateral shortfalls or be set aside for future contingencies.
iii. **Subordination or Credit Tranching:** Subordination or "credit tranching" serves as a protective measure for more senior bond classes. Essentially, the subordinated bond classes bear the losses before the senior bond classes do. This protective mechanism is known as a "waterfall" structure, highlighting the step-by-step flow of payments between bond classes during default scenarios.

Other external credit enhancement methods are third-party guarantees (from entities like banks or



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insurers), credit letters, and designated cash collateral reserves.

## Securitization Process

In a securitization setup, an entity might acquire a pool of assets (e.g., car loans). This entity could then issue multiple bond classes, each with different par values and risk profiles. In such a structure, payments prioritize the most senior tranche, which has the lowest risk and return. The hierarchy then descends to mezzanine tranches and junior or equity tranches with the highest risk and potential return.

## Distribution of Risk

If a total loss on the collateral is less than a specified amount, the most junior tranche absorbs this loss first. The next tranche would then bear any remaining balance, and so on. If the loss doesn't exceed a certain threshold, the senior tranches might remain unaffected, receiving their due payments. This setup allows investors to select their preferred risk level and get returns accordingly. Additionally, altering tranche features allows investors to pick an ideal mix of maturity, risk, and return characteristics.

## Risk Ratings & Bond Classes

Every bond class in a securitization gets a risk rating. This rating depends on both the collateral quality and the class's seniority. These ratings help investors gauge the credit risk of the bond class in conjunction with the collateral pool's credit risk. In many cases, certain bond classes might have better credit ratings due to collateralization or credit enhancement than those seeking to raise funds through securitization.



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## Question

Which of the following statements about the senior/subordinated structure in securitizations is most accurate?

A. The junior tranche, having the highest priority in payments, carries the least risk among all tranches.
B. The senior tranche always receives interest payments after all other tranches have been paid.
C. The mezzanine tranche carries a slightly higher risk than the senior tranche and typically offers better returns.

The correct answer is **C.**

The mezzanine tranche assumes a slightly higher risk than the senior tranche but offers higher returns.

**A is incorrect:** The junior tranche is the first to absorb losses and, as a result, carries the highest risk among all tranches. The statement misrepresents the risk profile of a junior tranche in securitization.

**B is incorrect:** The senior tranche, due to its priority in the hierarchy, receives payments before the other tranches and thus bears the least risk.



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## LOS 18c: describe types and characteristics of non-mortgage asset-backed securities, including the cash flows and risks of each type.

Non-mortgage asset-backed securities (ABS) encompass financial instruments collateralized by various non-mortgage assets. These include auto loans, credit card receivables, and personal loans.

# Amortizing vs. Non-Amortizing ABS

Amortizing ABS is secured by loans like residential mortgages and auto loans, where periodic payments cover both principal and interest. Over time, the number of these loans and their total value diminishes as they are paid off. On the other hand, non-amortizing ABS represents loans like credit card debt that do not have scheduled principal repayments. During the lockout or revolving period, the repaid principal is reinvested in new loans, replenishing the collateral pool.

## Credit Card Receivable ABS

Credit cards, provided by various institutions, offer a mechanism for payment and credit extension. When purchases are made, the issuer extends credit to the cardholder, creating a receivable. Pooling these receivables can form the underlying collateral for ABS.

## Benefits of Credit Card Receivable ABS

i. Balance Sheet Management: Credit card receivable ABS helps issuers offload credit card receivables from their balance sheet. This optimizes their capital structure.
ii. Reduction in Risk: ABS minimizes the cost of default risk from credit card debt, safeguarding the issuer against potential losses.
iii. Additional Revenue: Issuers are able to generate additional fee income through credit card receivable ABS.
iv. Reinvestment: The repaid principle is reinvested over the lockout or revolving period to acquire more loans. This helps maintain the pool size of the collateral.
v. Investor Protection: Provisions for rapid amortization can activate early principal repayments to protect investor interests during uncertain economic times.



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vi. Credit Enhancement: Credit card receivable ABS integrates multiple credit enhancement methods, such as subordination and over-collateralization, to boost its attractiveness to potential investors.

## Solar Asset-Backed Securities

Solar ABS has emerged as a prominent financing tool in the renewable energy sector, catering to homeowners' growing interests in solar energy systems. They are structured by specialized finance companies offering two distinct financing avenues: solar loans (borrowing to buy and install the system) and solar leases (renting equipment from a solar provider). The financial proposition of solar energy is dual-faceted, offering both environmental sustainability and cost savings. Solar ABS allows institutional investors to invest in environmentally-driven initiatives while targeting attractive risk-adjusted yields.

The green tag of solar ABS makes them ideal. Solar ABS is an attractive investment alternative for investors keen on ESG (Environmental, Social, Governance) considerations. Legally, solar ABS is anchored on the underlying debt—often mortgages, loans, or receivables. When pegged to solar energy system loans, the ABS can be likened to a junior mortgage on the property. Solar ABS are of interest to investors primarily because borrowers are usually creditworthy homeowners. Furthermore, built-in safeguards such as overcollateralization and subordination increase investor confidence by reducing default risks. Lastly, a distinct feature of many solar ABS is the **pre-funding period**, which permits the trust to acquire eligible assets for a set duration post-transaction.



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## Question

Which of the following best describes the primary safeguard for investors in a credit card receivable ABS during periods of economic volatility?

A. Extending the revolving period.
B. Lowering finance charges
C. Implementing rapid amortization provisions.

The correct answer is **C.**

Rapid amortization provisions in credit card receivable ABS act as a safeguard during economic uncertainties, ensuring investors are not overexposed to adverse changes in the asset pool.

**A is incorrect:** The revolving period's length is not typically altered to protect against economic volatility.

**B is incorrect:** Finance charges are not directly linked to investor protection during economic downturns.



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### LOS 18d: describe collateralized debt obligations, including their cash flows and risks.

Collateralized Debt Obligations (CDOs) are financial instruments issuing securities backed by diversified debt pools. These diversified pools can include corporate bonds, emerging market bonds, leveraged bank loans, and even other CDOs. Among them, the most common are Collateralized Loan Obligations (CLOs), backed primarily by leveraged bank loans.

## Classification of CDOs

i. Collateralized Bond Obligations (CBOs) are backed by corporate and emerging market bonds.
ii. Collateralized Loan Obligations (CLOs) are backed by leveraged bank loans.
iii. Structured Finance CDOs are backed by other CDOs.
iv. Synthetic CDOs are backed by a pool of credit default swaps or other structured securities.

## CDO Structure

CDO structures reallocate the cash flows generated by the underlying collateral to various tranches. However, unlike ABS, CDO pools are not static. A collateral manager who actively manages buying and selling debt obligations must ensure cash flows are sufficient for the CDO bondholders. A pivotal consideration for these transactions is the collateral pool's return rate compared to the funding costs. Since CDOs leverage transactions, equity tranche holders use borrowed funds to achieve a return surpassing the funding cost.

The CDO market mainly focuses on CLOs backed by senior secured bank loans. They offer a diversified portfolio of company loans.

## Key Features of a Generic CLO Structure

CLOs source funds for collateral assets by issuing various debt obligations, categorized into senior,



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mezzanine, and subordinated/junior/equity tranches. Investors in senior or mezzanine tranches may receive higher yields than corporate bonds or access debt products usually out of their reach. Meanwhile, equity tranche investors face risks similar to equity, with potential returns to match.

Cash Flow CLOs redistribute interest and principal payments, while market value CLOs depend on portfolio market value. On the other hand, synthetic CLOs use credit derivatives to create their collateral pool.

A distinctive aspect of CLOs is that their portfolio might not be finalized immediately after transaction closure. There is often a ramp-up period when more assets join the collateral pool. Once set, the manager can still swap out loans if replacements meet portfolio criteria. The CLO life cycle concludes when underlying loans mature and tranches receive payments in the defined order.

## Protective Measures in CLOs

CLOs employ various tests to ensure the bank loan collateral's cash flows meet the obligations of the various tranches. Overcollateralization tests are prevalent, ensuring the CLO's underlying bank loan pool's principal value does not surpass the issued notes' principal value. For instance, if a CLO promises USD600 million of principal across its tranches, it might need to procure USD780 million of bank loans, leading to an overcollateralization ratio of 1.30.

Additionally, each tranche in a CLO has its overcollateralization ratio targets. If the ratio dips below the set limit, cash flows divert to purchase more collateral or repay the most senior debt tranche. There are also other tests considering the diversity of borrowers, industry diversification, and even the credit ratings of the loans within the collateral pool.

Collateral managers are integral to the performance of CLOs, actively determining the asset mix, managing risks, and ensuring ongoing performance tests and collateral limits are adhered to. If these standards are not met, provisions mandate redirecting the principal payoff to the senior bond class.

## Risks Associated with CDOs



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i. Credit Risk: Since multiple debt obligations back CDOs, these underlying assets' default can impact CDO investors' returns. This risk is more pronounced in lower tranches, like equity ones.
ii. Liquidity Risk: CDOs, especially those of complex structures, may not be easily tradable in secondary markets. If many investors try to sell their CDOs simultaneously, it could depress prices.
iii. Interest Rate Risk: CDOs are susceptible to interest rate fluctuations like all fixed-income instruments. When interest rates rise, the price of CDOs can decline.
iv. Management Risk: The performance of CDOs, especially CLOs, depends significantly on the collateral manager. A manager's poor decision-making or lack of expertise can degrade the CDO's performance.
v. Reinvestment Risk: During periods of falling interest rates, the proceeds from callable bonds or maturing bonds within the collateral might get reinvested at lower rates, impacting returns.


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## Question

Which of the following best describes the role of an overcollateralization test in a CLO?

A. It ensures that the interest rates on the bank loans exceed the CLO's funding costs.
B. It confirms that the total principal value of the issued notes surpasses the principal value of the bank loan pool.
C. It ensures that the CLO's underlying bank loan pool's principal value does not exceed the issued notes' total principal value.

**Solution**

**The correct answer is C:** The overcollateralization test ensures that the principal value of the CLO's underlying bank loan pool does not exceed the total principal value of the notes issued by the various CLO debt tranches.

**A is incorrect:** This relates to the basic economics of CDO transactions, not the overcollateralization test.

**B is incorrect:** This represents the opposite of what the test ensures.



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# Learning Module 19: Mortgage Backed Security (MBS) Instrument and Market Features

## LOS 19a: define prepayment risk and describe time tranching structures in securitizations and their purpose.

## Prepayment Risk

Prepayment risk pertains to the possibility that the borrower repays the principal differently than the agreed schedule. It includes two facets: contraction risk and extension risk. Borrowers might change their repayment patterns based on changing interest rates. In a falling interest rate environment, borrowers are more likely to refinance their mortgages to capitalize on the lower rates. This is typical in places like the United States, where there are minimal penalties for early repayment. This implies that investors receive their principal back sooner than expected, shortening the term of the MBS. This forces them to invest at the lower, less favorable interest rates. This phenomenon is termed as **contractual risk.**

Conversely, in a rising interest rate environment, borrowers tend to hold onto their existing mortgages, avoiding refinancing. This situation, known as **extension risk**, prolongs the repayment period, causing investors to wait longer for their returns. Moreover, the longer duration combined with higher interest rates can diminish the present value of these future cash flows.

## Time Tranching

Time tranching in securitizations is a method designed to manage the unpredictability associated with prepayment risk, which arises when borrowers change their repayment patterns. This approach involves creating bond classes with distinct expected maturities to redistribute the prepayment risk among them. For example, using sequential tranching, a securitization pool can be designed such that principal repayments flow to one tranche first until its principal is fully paid off, then move on to the next tranche, and so forth.



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## Question

Which of the following best describes prepayment risk?

A. The risk that the borrower will pay higher interest than the contractually agreed rate.
B. The risk that the borrower will pay back the principal at a different pace from the contractually agreed schedule.
C. The risk that the borrower will default on the repayments of their loan.

**The correct answer is B:**

Prepayment risk is the possibility that the borrower repays the principal or a portion of the principal at a different pace than the contractually agreed schedule, either sooner or later than expected.

**A is incorrect:** Prepayment risk does not deal with interest rates but rather the pace of principal repayments.

**C is incorrect:** Prepayment risk does not pertain to defaults but to early or delayed principal repayments.



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**LOS 19b: describe fundamental features of residential mortgage loans that are securitized.**

## Mortgage Loans

Mortgage loans are secured loans where repayments are linked to a specific real estate asset. The lending entity can take possession of this asset due to the rights provided by the first lien and security interest on the property if a borrower defaults. The process, known as **foreclosure**, helps the lender recover the outstanding debt by selling the property.

### Loan-to-Value Ratio (LTV)

The loan-to-value ratio is the ratio of the loan amount to the property's valuation. The difference between the mortgage and the property's buying price is the down payment (the buying price is higher). A lower LTV means increased equity for the borrower. For the lender, this means the borrower has a reduced likelihood of a default. The LTV changes over time as the loan's outstanding balance decreases due to repayments, and the property's market value fluctuates.

$$\text{LTV} = \frac{\text{Loan amount}}{\text{House price}}$$

### Debt-to-Income Ratio (DTI)

Debt-to-Income ratio is an individual's monthly debt payments ratio to their pre-tax income. A lower DTI shows that a borrower can manage their monthly payments and can manage more debt. A higher DTI could alarm lenders as it may mean the borrower is overly leveraged.

$$\text{DTI} = \frac{\text{Monthly debt payment}}{\text{Pre-tax income}}$$

### Classification of Mortgages Based on Credit Quality

In nations like the United States, **prime loans** represent borrowers with solid credit backgrounds, lower DTIs, lower LTVs, and first lien on the property. **Subprime loans** are riskier with attributes like high DTIs or elevated LTVs.



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## Agency vs. Non-Agency Residential Mortgage-Backed Securities (RMBS)

Mortgages in MBS can be residential or commercial. RMBS arise from bonds backed by residential mortgages. In some countries, there is a difference between government-backed RMBS and those without this backing.

### Agency RMBS

These RMBS come with a certain guarantee level regarding the punctual payment of interest and principal repayment. Agency RMBS can further be divided into two categories:

i. **Guaranteed by a Federal Agency**: The government guarantees timely interest payment and principal repayment. It is a firm assurance that the securities will fulfill their promised cash flows.
ii. **Guaranteed by Government-Sponsored Enterprises (GSEs)**: This category includes RMBS issued by GSEs. They do not have the full backing of the federal government. Instead, they offer guarantees for the punctual payment of interest and principal on the securities. As a service, GSEs typically charge a fee for this guarantee. It's a promise based on the credibility and financial strength of the GSE rather than the government itself.

### Non-Agency RMBS

These securities are not guaranteed by any federal agency or GSE. They are typically issued by private entities like banks, financial institutions, or other businesses. They have credit enhancements in the form of pool insurance, letters of credit, or subordination to appeal to investors. The mortgages backing non-agency RMBS are often termed as non-conforming mortgages. They might have higher Loan-to-Value (LTV) ratios or be associated with borrowers of lower credit quality.

## Mortgage Contingency Features



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Borrowers may have a prepayment or early repayment option that allows them to prepay all or part of the outstanding mortgage principal before maturity. This poses a prepayment risk for lenders as the exactness of cash flow timings and amounts become unpredictable. To minimize this uncertainty, lenders often impose prepayment penalties. The penalties compensate for differences between the contract and prevailing mortgage rates.

The mortgage can default if a borrower fails to adhere to the payment schedule. This allows the lender to initiate foreclosure. The amount recovered after the property's sale might be inadequate to cover the losses. In **recourse loans**, lenders can claim the difference between the outstanding amount and sales proceeds from the borrower. **Non-recourse loans** do not permit lenders to make such claims and can only recover the balance through the property. The type of loan, whether recourse or non-recourse, impacts the borrower's default likelihood, especially where the LTVs are higher than 100%. Depending on the mortgage's nature, borrowers may consider a strategic default, where they intentionally default, weighing the consequences against potential benefits.

## Underwater Mortgages

Negative equity or underwater mortgages are where the owed amount exceeds the property's value. This situation means the homeowner owes more on the mortgage than the property is currently worth. Strategic default becomes more likely with non-recourse loans when LTV exceeds 100%.

A borrower can make a deliberate decision to stop making payments on a debt despite having the financial ability to make the payments. This is called **strategic default.** Strategic default becomes more likely with non-recourse loans as the borrower’s liability is limited to the property itself. Additionally, when the LTV is greater than 100%, meaning the property value is entirely overshadowed by the owed amount, the likelihood of a strategic default increases. underwater mortgages can be precursors to foreclosures and were prominent during the 2008-09 Global Financial Crisis.



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## Question

Which of the following best describes a recourse loan?

A. A loan in which the lender can claim only the property in case of default.
B. A loan in which the lender can claim the difference between the outstanding mortgage balance and property sale proceeds from the borrower's other assets or income.
C. A loan that carries a prepayment penalty to compensate the lender if the borrower decides to pay off the loan earlier than the agreed schedule.

The correct answer is **B.**

A recourse loan allows the lender to claim the difference between the outstanding mortgage balance and the sales proceeds from the borrower's other assets and/or income in case of a shortfall after selling the property.

**A is incorrect:** This describes a non-recourse loan, where the lender can only claim the property as collateral in the case of default and cannot go after the borrower's other assets or income.

**C is incorrect:** While some loans carry a prepayment penalty, this feature is not specific to recourse loans and does not define the nature of recourse in a loan.



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**LOS 19c: describe types and characteristics of residential mortgage-backed securities, including mortgage pass-through securities and collateralized mortgage obligations, and explain the cash flows and risks for each type.**

Residential Mortgage-backed Securities (RMBS) are securities derived from the pooling of mortgages and their subsequent sale to investors. The section discusses the different types of RMBS, including mortgage pass-through securities, non-agency RMBS, and collateralized mortgage obligations.

## Mortgage Pass-Through Securities

Mortgage Pass-Through Securities result from lenders combining multiple mortgages and selling these as securities to investors. The arising monthly payments of principal, interest, and prepayments from the mortgage pool are passed to the investors.

### Features of Mortgage Pass-Through Securities

i. **Cash Flows**: These depend on monthly flows from the underlying mortgage pool. They cover both amounts passed to holders and administrative fees for servicing the pool.
ii. **Administrative Charges:** These arise from tasks such as collecting payments from borrowers, maintaining mortgage records, and initiating foreclosure if necessary. These charges and any guarantee fees from the issuer are a fraction of the mortgage rate.
iii. **Pass-Through Rate:** It is the coupon rate of the mortgage pass-through security. It is lower than the weighted average mortgage rate due to administrative costs.
iv. **Heterogeneous Nature:** Mortgages in the pool differ in outstanding principal, interest rates, and maturities. The formula below calculates the weighted coupon rate (WAC) and the weighted average maturity (WAM) for each security.

WAM represents the average time until the mortgages in a pool are expected to be repaid, while WAC indicates the weighted average interest rate of the mortgages in the pool.

$$\text{WAC} = \sum \left(\frac{\text{Current balance of each mortgage}}{\text{Total current balance of all mortgages}} \times \text{Interest rate of each mortgage}\right)$$



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$$WAM = \sum \left( \frac{\text{Current balance of each mortgage}}{\text{Total current balance of all mortgages}} \times \text{Number of Months to Maturity of each mortgage} \right)$$

The pass-through rate is the interest rate received by the RMBS investors. This is less than the WAC due to administrative charges.

$$Pass-Through\ Rate = WAC - Administrative\ Charges$$

## Example: Calculating WAC and WAM

Given the information in the table below, calculate the weighted average coupon rate (WAC) and the weighted average maturity (WAM).

| Mortgage | Interest rate | Beginning Balance (EUR) | Current Balance (EUR) | Original Term (months) | Number of Months to Maturity |
|---|---|---|---|---|---|
| A | 2.8% | 450,000 | 408,000 | 360 | 288 |
| B | 3.5% | 370,000 | 340,000 | 600 | 516 |
| C | 3.0% | 210,000 | 185,000 | 288 | 216 |
| D | 4.1% | 500,000 | 240,000 | 480 | 192 |
| E | 3.4% | 270,000 | 252,000 | 384 | 288 |
| | | 1,800,000 | 1,425,000 | | |

## Solution

Weighted Average Coupon Rate (WAC):

$$WAC_A = \left( \frac{408,000}{1,425,000} \times 2.8\% \right) = 0.8017\%$$

$$WAC_B = \left( \frac{340,000}{1,425,000} \times 3.5\% \right) = 0.8351\%$$

$$WAC_C = \left( \frac{185,000}{1,425,000} \times 3.0\% \right) = 0.3895\%$$

$$WAC_D = \left( \frac{240,000}{1,425,000} \times 4.1\% \right) = 0.6905\%$$

$$WAC_E = \left( \frac{252,000}{1,425,000} \times 3.4\% \right) = 0.6013\%$$



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$$Total\ WAC = 0.8017\% + 0.8351\% + 0.3895\% + 0.6905\% + 0.6013\% = 3.3180\%$$

Weighted Average Maturity (WAM):

$$WAM_A = (\frac{408,000}{1,425,000} \times 288) = 82.46$$

$$WAM_B = (\frac{340,000}{1,425,000} \times 516) = 123.12$$

$$WAM_C = (\frac{185,000}{1,425,000} \times 216) = 28.04$$

$$WAM_D = (\frac{240,000}{1,425,000} \times 192) = 32.34$$

$$WAM_E = (\frac{252,000}{1,425,000} \times 288\ ) = 50.93$$

$$Total\ WAM = 82.46 + 123.12 + 28.04 + 32.34 + 50.93 = 316.88\ months$$

The WAC is 3.318%, and the WAM is approximately 317 months.

### Risks Associated with Mortgage Pass-Through Securities

i. Prepayment Risk: Homeowners may choose to refinance or sell, leading to an earlier-than-expected mortgage payoff, especially in a declining interest rate environment. This can alter the anticipated cash inflows for investors.
ii. Extension Risk: In a scenario of rising interest rates, homeowners may postpone refinancing, which can extend the timing of expected cash inflows.
iii. Administrative Risk: Costs related to administrative tasks, such as payment collections or initiating legal actions for defaults, can influence the net earnings of investors.

## Collateralized Mortgage Obligations (CMOs)

CMOs transform mortgage pass-through securities or various loan pools into securitized forms. They are structured with multiple classes or tranches, each having different priority levels for the receipt



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of principal and interest payments. Principal and interest payments are directed to the tranches then released to investors. The **tranching structure** enables prepayment risk to be allocated across the different tranches. This reduces the uncertainty on the amount and timing of payments received by investors. The higher the tranche level, the lower its exposure to prepayment and default risks.

## Collateralized Mortgage Obligations Structures

The structures result from the various methods of organizing cash flows from a mortgage pool.

i. Sequential-Pay CMO Structure: In this structure each tranche is settled in order, where one class gets principal payments only after the prior class is fully settled.
ii. Z-Tranches: Also known as accrual or accretion bonds. These tranches do not disburse interest until a pre-set date. They accrue interest during an initial period and then start distributing interest and principal payments only after other specified tranches (often referred to as support or companion tranches) have been paid off. They are usually the final tranche in a sequence, making them riskier and challenging to value.
iii. Principal-Only (PO) Securities: Investors receive only principal repayments from the mortgage pool for these securities. This makes their value sensitive to prepayment and interest rates.
iv. Interest-Only (IO) Securities: These securities disburse only interest payments from the pool and have no par value. The cash flows to the holders of this security reduce with increased prepayments.
v. Floating-Rate Tranches: These tranches bear variable interest rates tied to an index. They can be structured as inverse floaters, where interest paid varies inversely with interest rate changes.
vi. Residual Tranches: These tranches collect any leftover cash flow after settling other tranches.
vii. Planned Amortization Class (PAC) Tranches: They are an evolution of sequential-pay CMOs and provide greater cash flow predictability. They ensure fixed principal payments over a set period if prepayment rates remain within specified bounds.



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## Risks Associated with CMOs

i. Prepayment Risk: CMOs distribute the prepayment risk across tranches. While they do not eradicate this risk entirely, they can vary its impact across different tranches.
ii. Default Risk: The seniority of a tranche in a CMO structure determines its exposure to default risk. More senior tranches have reduced exposure.
iii. Interest Rate Risk: Depending on the structure, some tranches might be more susceptible to changes in interest rates, affecting their returns.



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## Question

Which of the following is the most accurate definition of a collateralized mortgage obligation (CMO)?

A. A security that pools together multiple mortgages and is structured to direct interest and principal payments to different classes of bondholders.
B. A debt security issued by banks, backed only by the general creditworthiness of the issuing bank.
C. A mortgage-backed security solely based on commercial real estate loans.

The correct answer is **A.**

A collateralized mortgage obligation (CMO) is a type of mortgage-backed security that pools multiple mortgages and directs bondholders' interest and principal payments to different classes (or tranches) in a predefined order.

**B is incorrect:** This describes a bank's unsecured debt, not a CMO.

**C is incorrect:** While mortgage-backed securities are based on commercial real estate loans, this does not accurately describe a CMO's specific structure and nature.



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## LOS 19d: describe the characteristics and risks of commercial mortgage-backed securities.

CMBS are backed by a pool of commercial mortgages on diverse income-producing properties such as office buildings, multifamily properties, industrial properties, shopping centers, and health care facilities. These securities are repaid from the property's generated revenue. They have collateral generally consisting of commercial loans, whether for property acquisition or refinancing.

### CMBS Structure

CMBS and RMBS are similar in their securitization processes. However, CMBS has two distinctive features: call protection and the balloon maturity provision.

#### Call Protection

CMBS have protection against early repayments, allowing them to trade more like corporate bonds. This protection is either structural or at the loan level.

1. Structural Call Protection: This is done through sequential-pay tranches. This means that principal repayments are directed to the highest-priority tranche until it is fully paid off, after which the next tranche in line starts receiving payments. This structure ensures that higher-rated tranches are paid off before lower-rated tranches, protecting senior investors against prepayments and other risks.
2. Loan Level Call Protection: This relies on three mechanisms, namely, prepayment lockout (prohibits prepayments during a specified period), prepayment penalty points (penalties a borrower must pay if they wish to refinance), and defeasance (allows prepayment but requires the borrower to buy a government securities portfolio replicating the loan's cash flows).

#### Balloon Maturity Provision

Commercial mortgages are not fully amortizing over the life of the loan. They require interest and some principal repayments throughout the loan's life, with a large "balloon" payment at maturity. The borrower might fail to make the large payment, resulting in balloon risk. This can lead to an



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extension of the loan term, known as the "workout period." Balloon risk is, therefore, a type of extension risk.

## Risk Indicators in Commercial Real Estate Lending

The two critical indicators of credit performance in commercial real estate lending are the Loan-to-Value ratio (LTV) and the Debt Service Coverage ratio (DSCR). LTV determines the ratio of the loan amount to the property value. On the other hand, DSCR is determined by dividing the property's annual Net Operating Income (NOI) by the debt service. A DSC ratio above 1.0× indicates cash flows from the property can adequately cover the debt service.

$$\text{NOI} = (\text{Rental income} - \text{Cash operating expenses}) - \text{Replacement reserves}$$

$$\text{DSC Ratio} = \frac{\text{Net operating income}}{\text{Debt service}}$$

## CMBS Risks

1. Concentration Risk: Unlike RMBS, which is often backed by a large number of residential mortgages, CMBS can be backed by a limited number of commercial mortgages. This limited diversification means that a default on a single mortgage within the CMBS can significantly impact the returns for investors.
2. Balloon Risk (A Form of Extension Risk): Many commercial loans within CMBS are structured as balloon loans. These loans require significant principal repayments at maturity. If a borrower fails to make this balloon payment at the loan's end, it leads to default. In such cases, lenders might extend the loan duration, known as the "workout period," and possibly modify the loan's original terms. Since the loan life gets prolonged, this risk is also seen as a type of extension risk.
3. Call Protection Risks: One distinctive feature of CMBS is the protection against early prepayments. While this might seem beneficial, it comes with its own set of risks. For instance, structural call protection ensures that a lower-rated tranche cannot be paid down until a higher-rated tranche is entirely paid off. This mechanism protects senior tranches but increases the risk for junior tranches. On the individual loan level, mechanisms such as prepayment lockouts, prepayment penalty points, and defeasance can affect the CMBS's



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liquidity and yield.

4. Legal Risks (Especially in European CMBS): European CMBS often includes loans originating from different European countries. If a foreclosure or bankruptcy occurs, the property sale has to adhere to local rules, which can differ significantly across European nations. Such variations can introduce uncertainties and complexities, making European CMBS riskier from a legal standpoint.
5. Interest Rate and Prepayment Risks: While CMBS offers protection against prepayments, they are not immune to interest rate risks. European CMBS, for instance, generally have a floating rate that might be capped, making them susceptible to interest rate fluctuations. In the U.S., while CMBS typically have fixed rates, they can sometimes offer a floating rate. The structure of the CMBS, especially regarding the interest rate type, can thus influence its sensitivity to market interest rate changes.
6. Credit Risk: The credit risk in CMBS can vary based on the underlying assets. If a CMBS is backed by a single or a few commercial mortgages, the credit risk might be higher compared to an RMBS backed by many residential mortgages. The creditworthiness of the properties, their owners, and the nature of the commercial mortgages are vital factors determining the CMBS's credit risk.

## CMBS vs. RMBS

1. Underlying Assets: CMBS pools might consist of one or a limited number of mortgages, while RMBS usually contains numerous residential mortgages.
2. Issuer: CMBS can be issued by various financial institutions, whereas RMBS can be issued by either government entities or private businesses.
3. Rate: In Europe, CMBS often carry a floating rate (possibly capped), whereas in the US, they typically have a fixed rate. RMBS can be either.
4. Risk Exposure: CMBS is generally more exposed to credit risk due to its potential concentration in a few mortgages. Prepayment risk dynamics differ between CMBS and RMBS, with CMBS having a higher extension risk and RMBS having both high contraction and extension risks.



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## Question

Which of the following is *most likely* to be a risk associated with the balloon maturity provision in CMBS?

A. Interest rate risk.
B. Prepayment risk.
C. Extension risk.

The correct answer is **C.**

Balloon risk, a form of extension risk, arises when a borrower fails to make the balloon payment at maturity.

**A is incorrect:** Interest rate risk is associated with fluctuations in interest rates, not balloon payments.

**B is incorrect:** Prepayment risk is related to early payment, not balloon payments.



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