Bonds Overview

Main Principles of Bonds

Debt instruments

Typically fixed maturity date

Typically regular interest payments

Coupon

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What distinguishes a bond from a loan?

BONDS

- Offer greater liquidity
- A relatively active secondary market
- Bonds can be sold before maturity

LOANS

- More complex to sell
- Require more time to completion
- Higher transaction costs

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1

Issuer

The entity borrowing the money

Government

Corporation

Other

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2

Maturity date

The date when the bond reaches the **end of its life**

The principal amount repaid to bondholders

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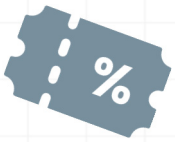
3



Coupon

The **interest rate paid** to the bondholder on a regular basis

The income an investor earns for holding the bond

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Par value/face value

(Principal amount or notional)

The amount of money the bondholder will be repaid at the bond's maturity

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5

Price

The bond's current market value (percentage of face value)

Bond prices fluctuate due to **interest rate movements**

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Bond Price Quotation

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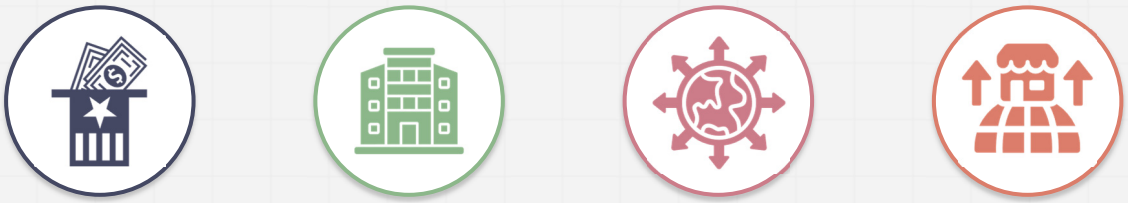
Bond markets have evolved over time in terms of **how they quote prices**



Fractional Quotation | **Decimal Quotation**

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Fractional Quotation | Decimal Quotation

U.S. Treasury Bonds

Historically, U.S. Treasury Bonds were quoted in fractions, specifically in 32nds of a dollar

U.S. Treasury note with a quoted price of 100-7 → The bond is trading at **100** and **7/32nds of its par value**

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Fractional Quotation

Decimal Quotation

Example bond:	US Treasury Note
Quoted price:	100-7
Interpretation:	The bond is trading at 100 and 7/32nds of its par value
Decimal equivalent:	100.2188%
Par value:	100,000 USD
Price in USD	100,218.80 USD

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Fractional Quotation

Decimal Quotation

A gradual shift towards decimal pricing started in the early 2000s

Modernize and **simplify** bond trading

Align bond markets with broader trend in financial markets towards **decimalization**

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Fractional Quotation

Decimal Quotation

European and Other International Markets

Widely used metric system

Global trend towards **decimalization in financial markets**

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Fractional Quotation

Decimal Quotation

Example bond:	Japanese government bond
Quoted price:	100.9290
Interpretation:	The bond is trading at 100.9290% of its par value
Par value:	100,000,000 JPY
Price in JPY:	100,929,000 JPY

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Fractional Quotation

Decimal Quotation

Emerging Markets

The quoting convention can vary

Transitioning to decimal pricing

Aligns with **international standards**

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Bond Redemption

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Fixed Maturity

Bullet Bonds

Variations

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Fixed Maturity

Bullet Bonds

Variations

The date on which investors will get their **money back** is set at the time the **bond is issued**

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Fixed Maturity

Bullet Bonds

Variations

Repaid in a **single payment** at **maturity**

No amortization features or partial repayment

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Fixed Maturity

Bullet Bonds

Variations

Amortizing bonds

Part of the face value is **periodically repaid** throughout the life of a bond

As the bond matures, Its **face value declines**

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Fixed Maturity

Bullet Bonds

Variations

Callable bonds

The issuer holds the option to repay investors before **maturity** and **stop coupon payments**

Can only be called on **certain dates**, typically outlined in the **bond's terms**

A **higher risk for investors** since their future cash flows are less certain

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Fixed Maturity

Bullet Bonds

Variations

Extendable bonds

The issuer has the right to **extend the bond's maturity** on specific future dates

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Fixed Maturity

Bullet Bonds

Variations

Option to **shorten the bond's life**

Callable bonds

Extendable bonds

Option to **lengthen bond's life**

The **issuer** is granted an option to **alter the maturity**, and in exchange, investors are compensated with **higher coupon payments**

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Fixed Coupon Bonds

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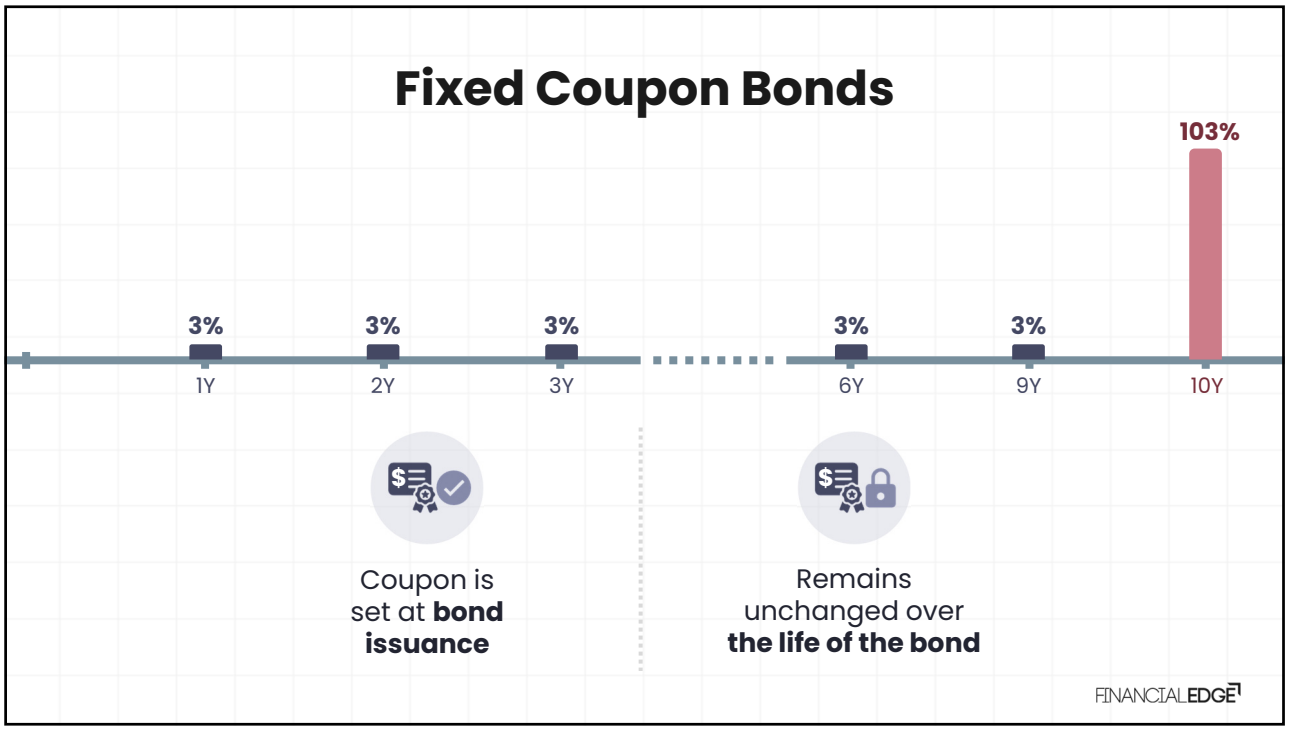

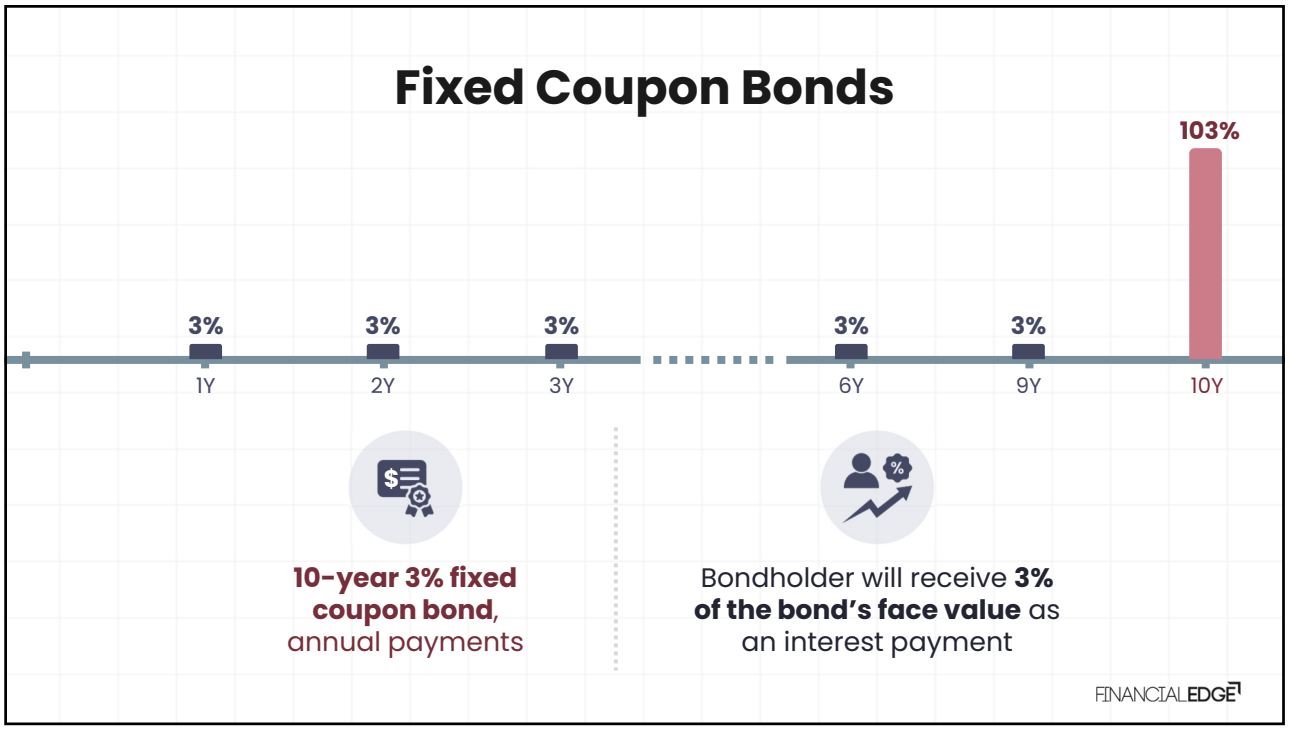

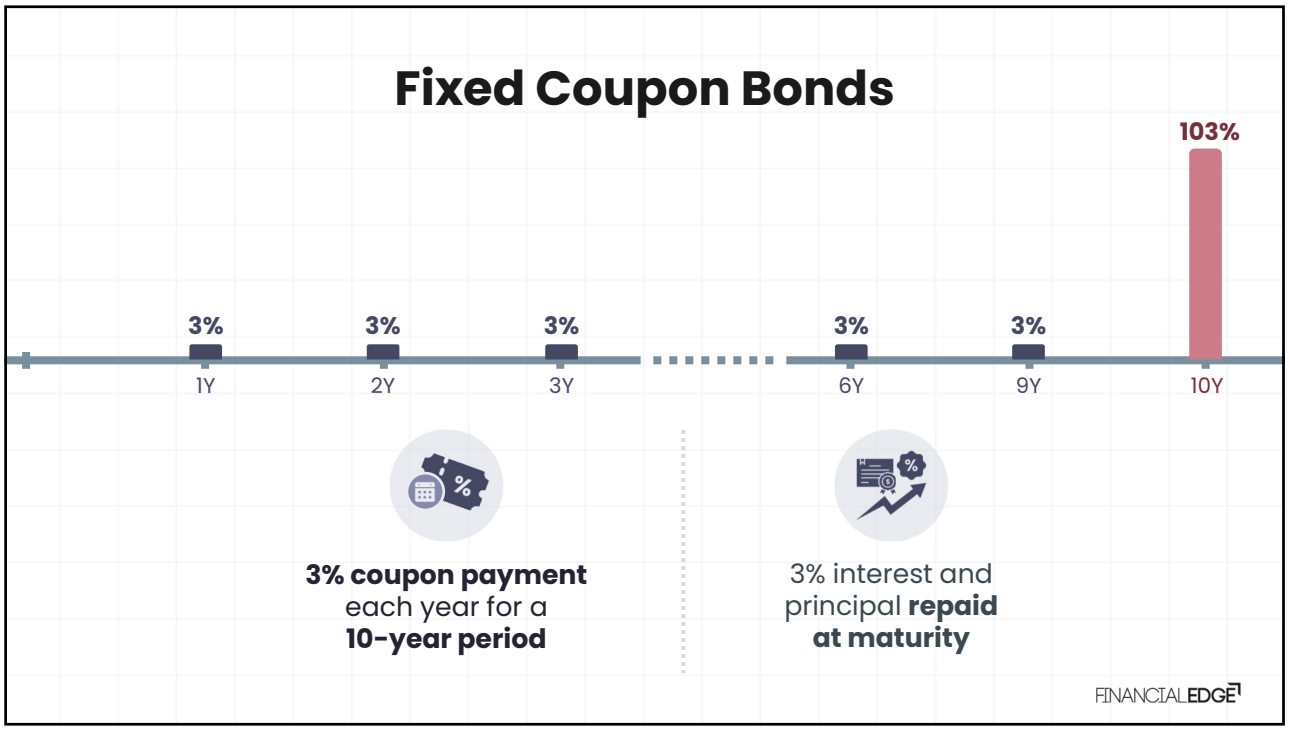

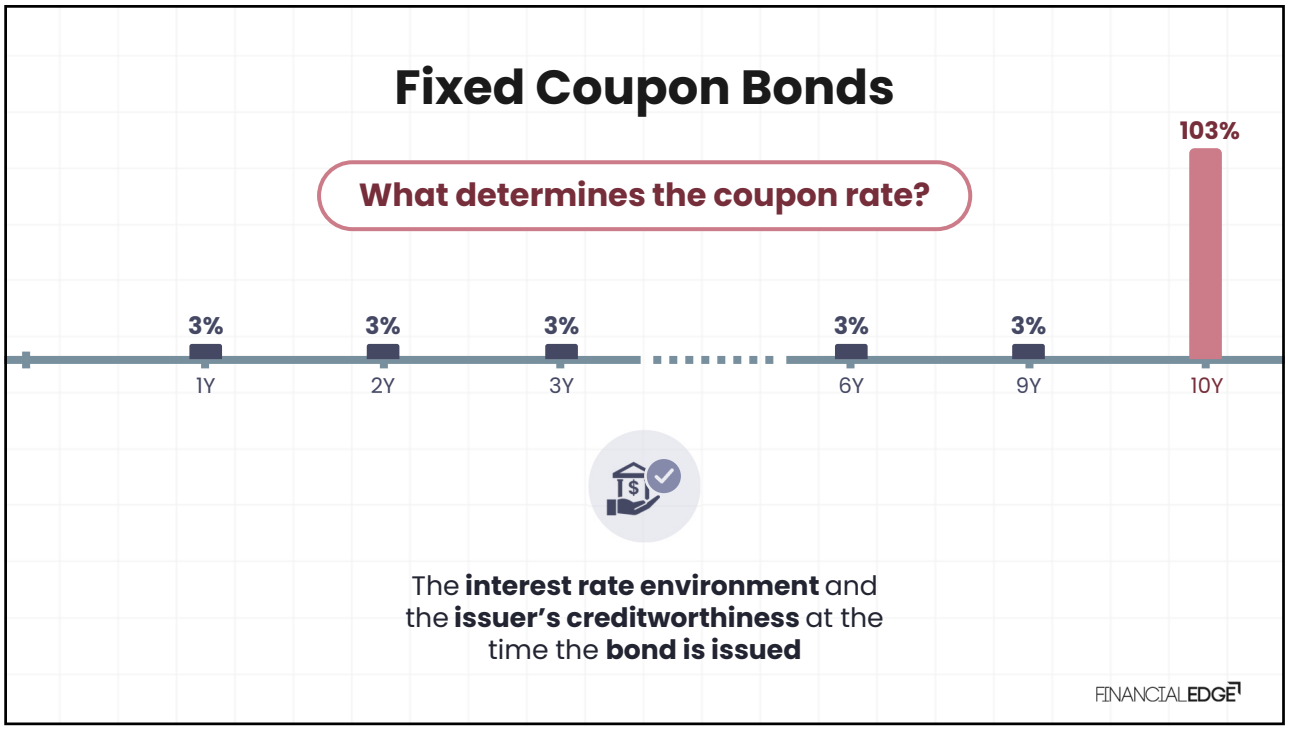

Zero Coupon Bonds

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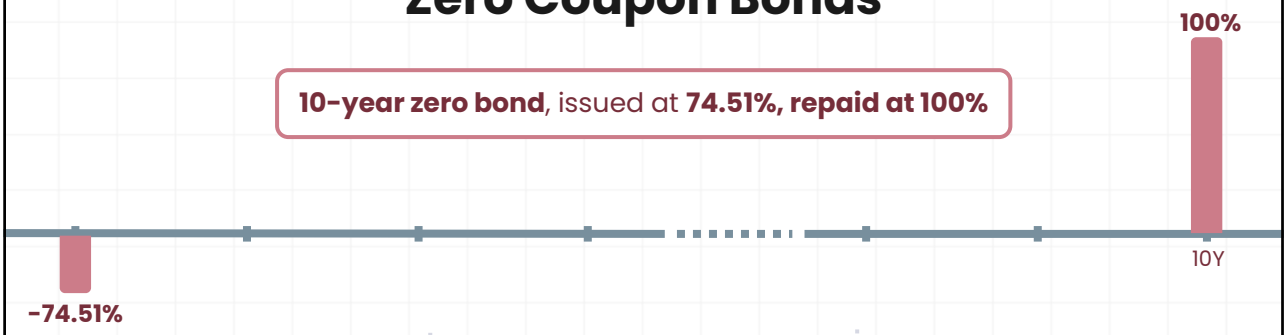
Zero Coupon Bonds

10-year zero bond, issued at **74.51%, repaid at 100%**



No interest payment between **issuance and maturity** of the bond

Sold at a **discounted price, repaid at 100%**

The return is given by the difference between **issue and redemption price**

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Floating Rate Notes (FRNs)

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Floating Rate Notes (FRNs) or **"floaters"** are bonds with variable rates

Coupon formula is set when the **bond is issued**

References IBOR (Interbank Offered Rate) or the newer **risk-free rates** (RFRs)

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Floating Rate Notes (FRNs) Examples

IBOR (EURIBOR)	**RFR** (SOFR)
Interbank Offered Rates (IBOR)	Risk-Free Rate (RFR)
Euro Interbank Offered Rate (EURIBOR)	Secured Overnight Financing Rate (SOFR)

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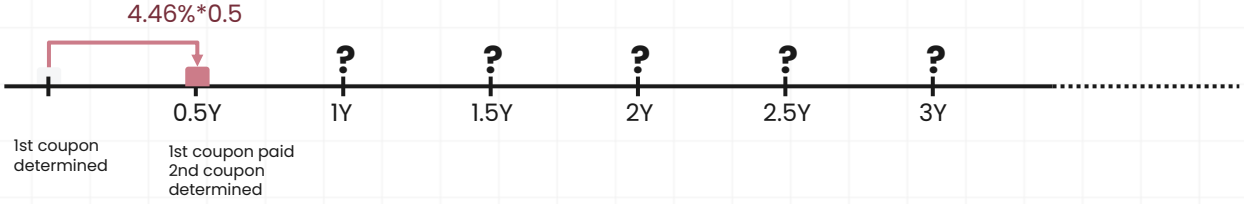
IBOR (EURIBOR)

10-year FRN PAYS **6M EURIBOR** + **0.50% payments** **semi-annual**

6M EURIBOR fixing for issue date 3.96%



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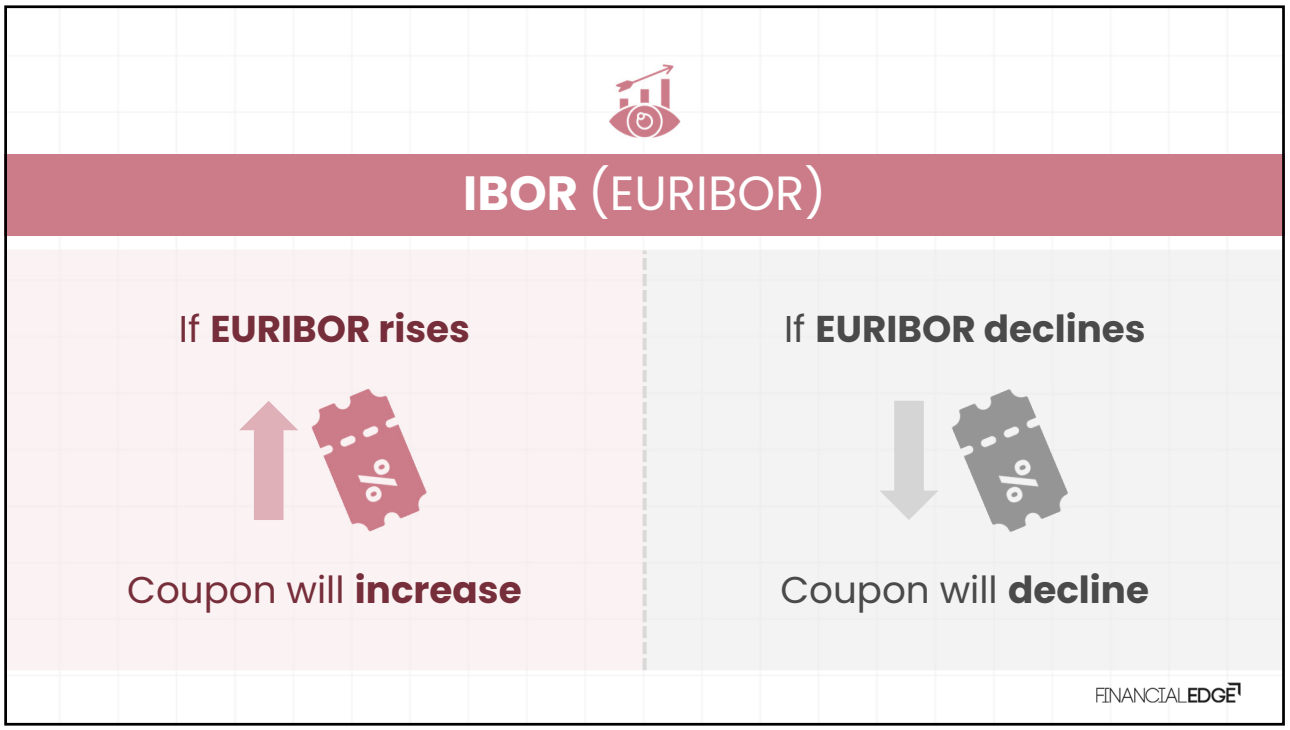

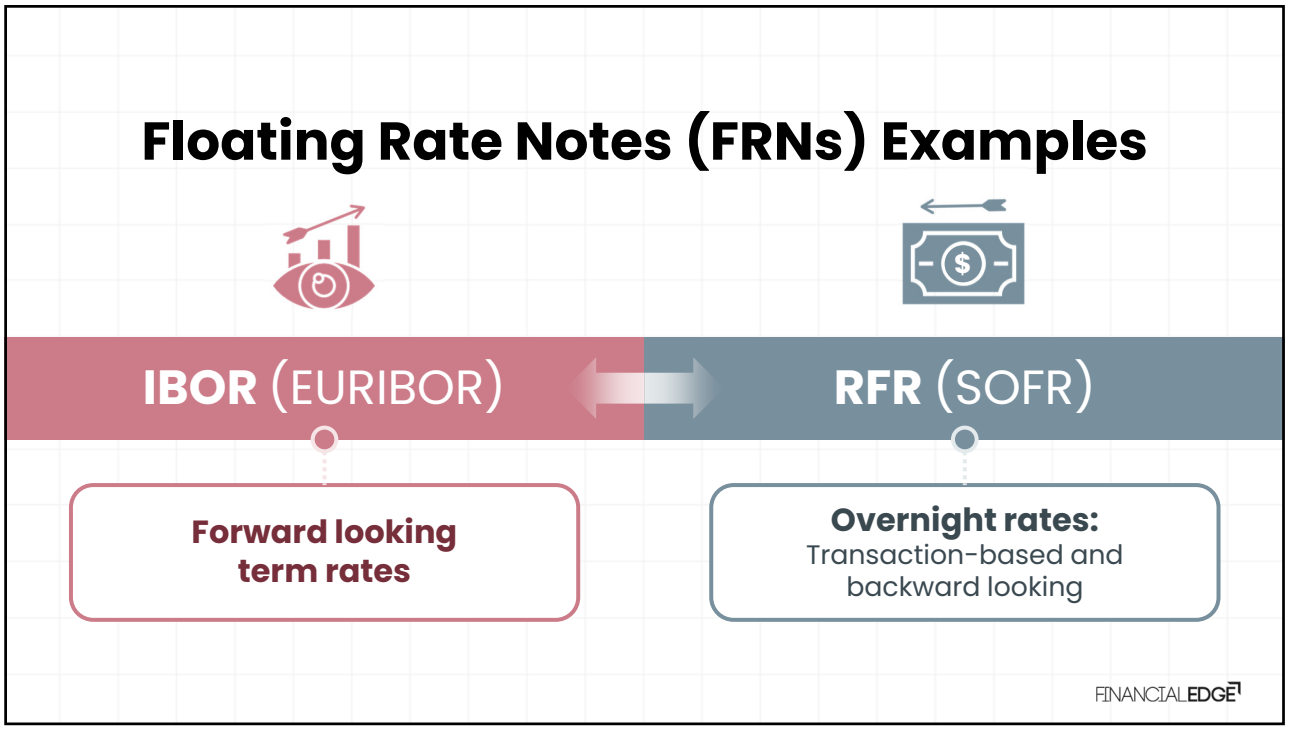

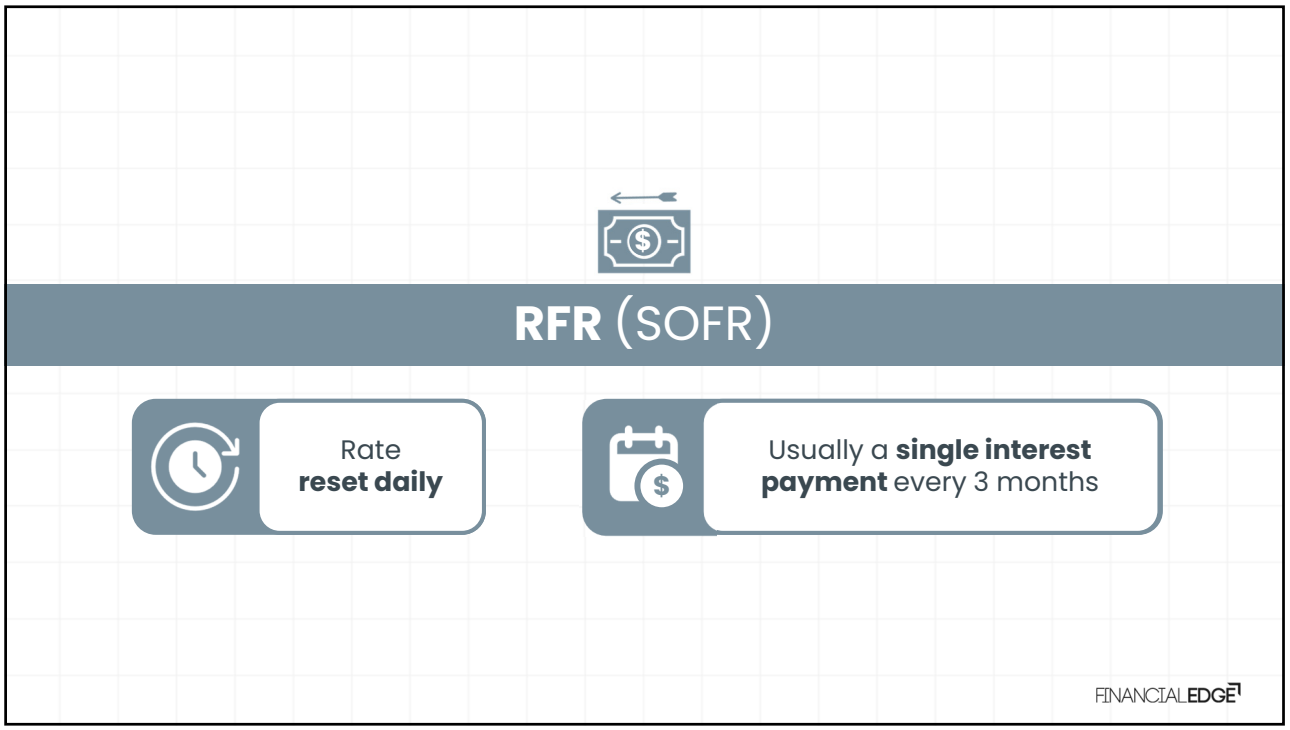

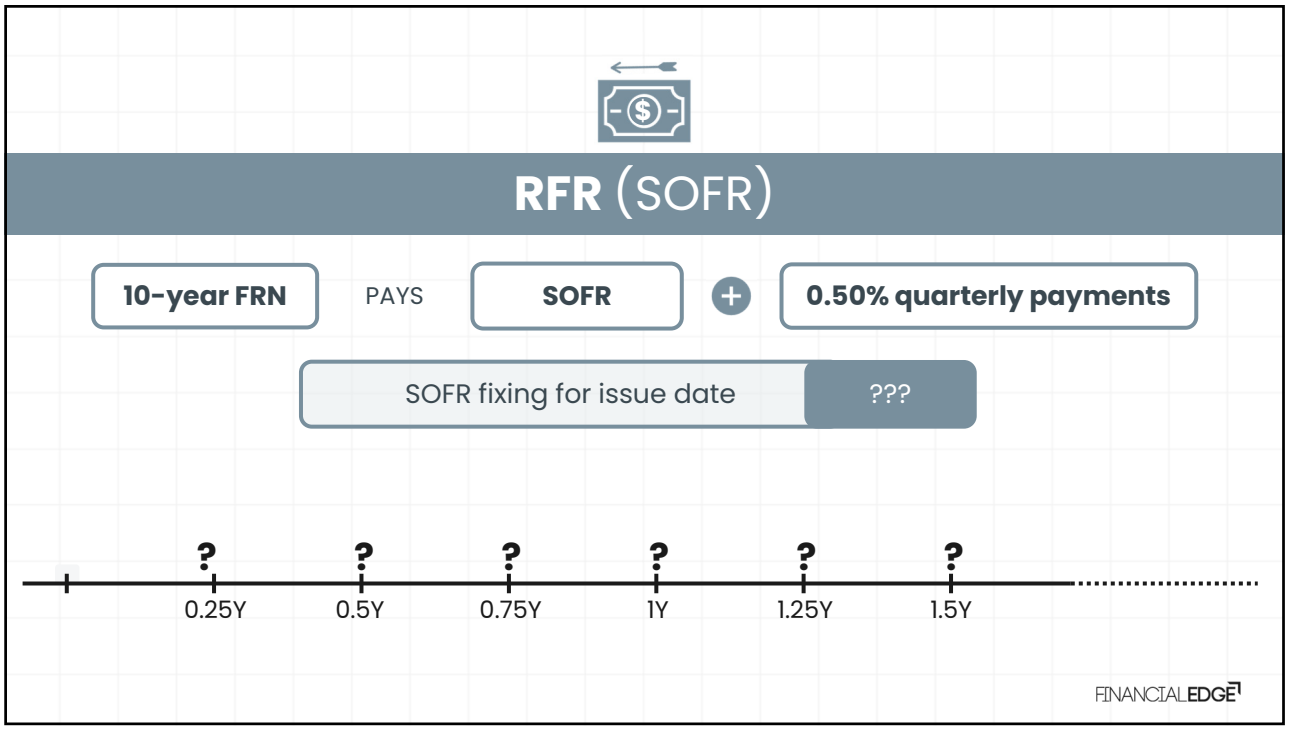

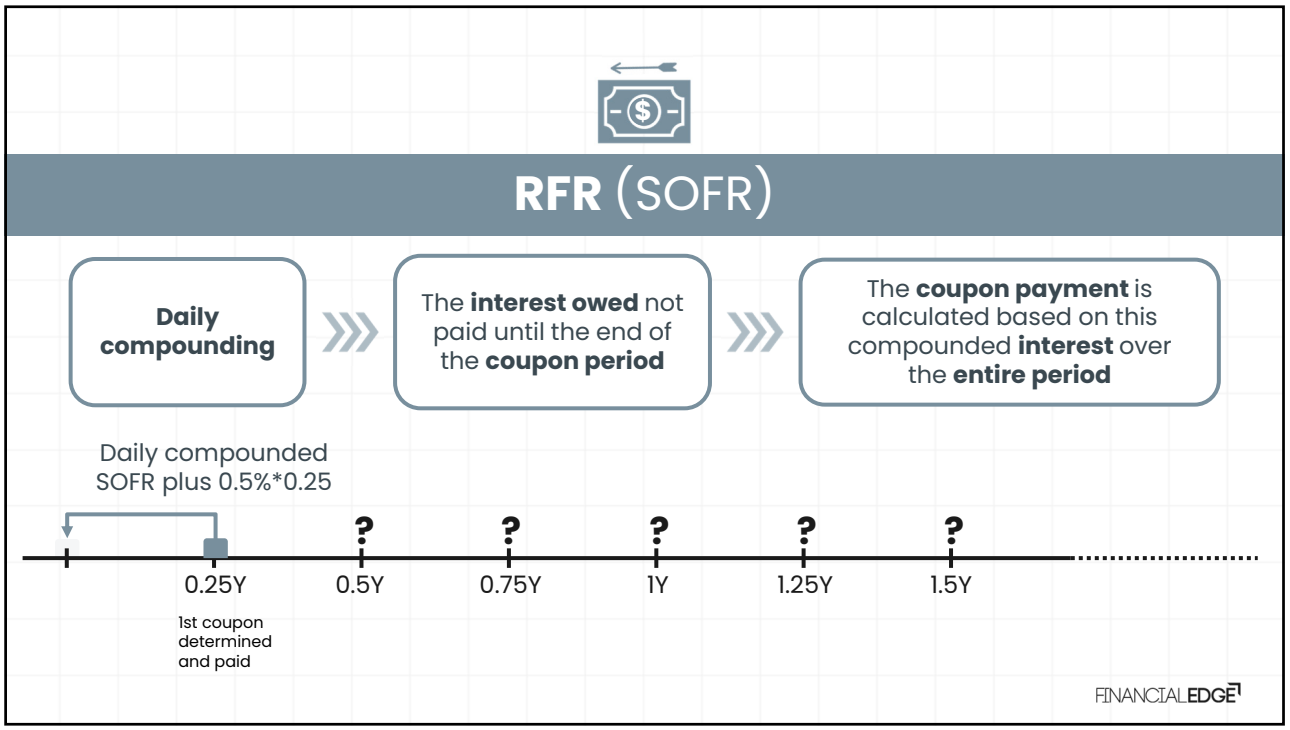

Pricing a Fixed Coupon Bond – The General Approach

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Bonds are **often quoted in price terms**

Price

Showing the **percent of notional** that an **investor must currently pay** for the bond

How can a bond be priced?

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Time Value of Money (TVM)

The **present value** of a **cash flow** is **different** from its **future value**

Present money has the potential to earn **interest or investment returns**, while future money is **not immediately** available for use

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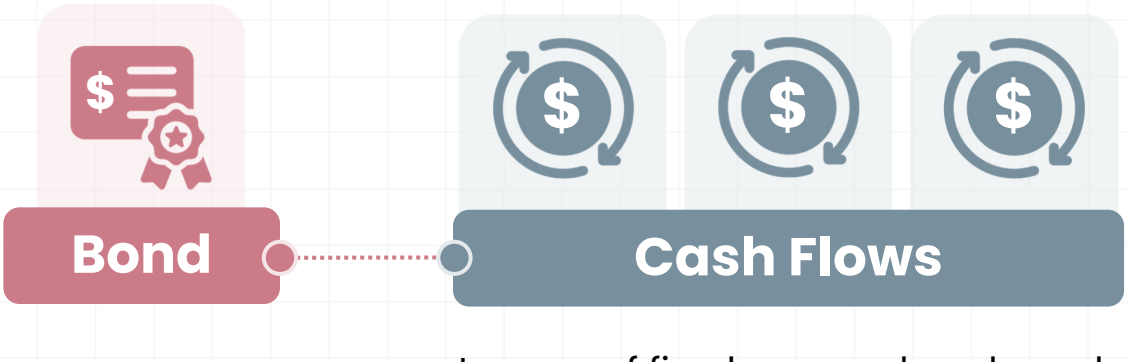

In case of fixed coupon bonds cash flows are known in size and timing

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$$\text{Coupon Bond Price} = \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \frac{C_n + FV_n}{(1+r)^n}$$

C	Coupon amount per period
FV	Face value
r	Required rate of return, per period
n	Number of periods to maturity

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The price of a bond is the **sum of the present values** of all **outstanding coupon payments** and the **redemption payment**

$$\text{Coupon Bond Price} = \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \frac{C_n + FV_n}{(1+r)^n}$$

C	Coupon amount per period
FV	Face value
r	Required rate of return, per period
n	Number of periods to maturity

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At **issuance**, the **bond price** is set so that:

Coupon payments

Final redemption value

Investors achieve their required rate of return

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Bond price in the **secondary market**

Supply and demand factors

Changes in interest rates

Changes in issuer's creditworthiness

Premium (above face value)

Discount (below face value)

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Government Bond Issuance - Overview

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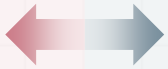
Bond Pricing – Practical Example



Government Bond

Corporate Bond

The process leading to the **actual pricing might differ**

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Government Bond

Issued via **public auctions**

The issuer **places securities** directly with **investors**

Investors submit orders for the **yield they desire**

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Bond Pricing – Concrete Example

$10 billion of a 5-year bond via auction

Yield	Demand	Aggregated demand
4.522%	3.4 bn USD	3.4 bn USD
4.523%	4.9	8.3
4.524%	2.5	10.8
4.525%	1.3	12.1
4.526%	1.1	13.2
4.527%	0.5	13.7

Highest accepted yield

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Yield to Maturity

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In the **secondary market**, the bond price is typically determined by:

Supply   **Demand**

✕ Pricing calculations are **less necessary** ✕

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Investors are keen to understand **the return** they would provide

Yield to Maturity (YTM)

Solve for **r** so that: $\frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \frac{C_n + FV_n}{(1+r)^n}$ = **market price of bond**

Adjusting the **discount rate** used in the formula shown until the sum of the **bond's future cash flows equals** its current **market price**

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YTM based on the following assumptions:

1. Bond is purchased at the **current market price**
2. Bond is held to **maturity**
3. Coupons are **reinvested,** and the reinvestment rate achieved is **equal to the yield to maturity**

Constant **reinvestment rate** for all coupons **equal to the YTM** at the time of the bond purchase

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Yield to Maturity Components

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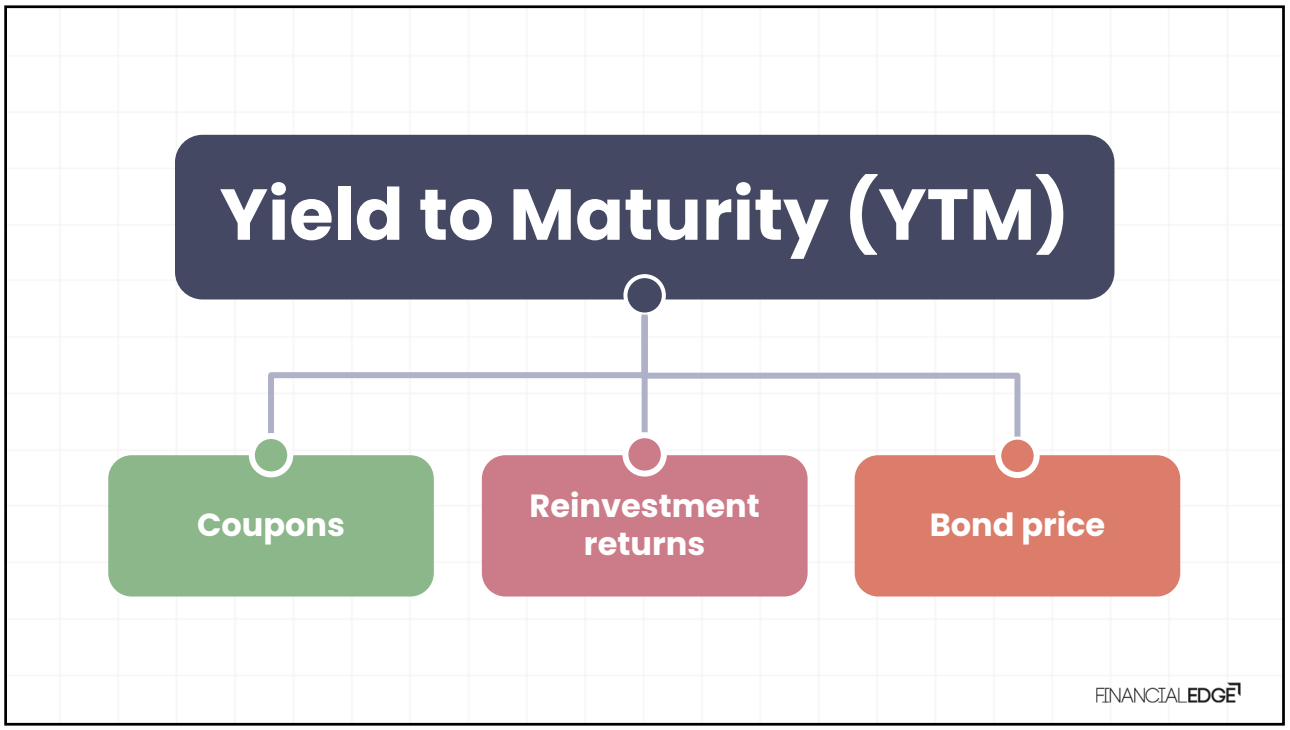

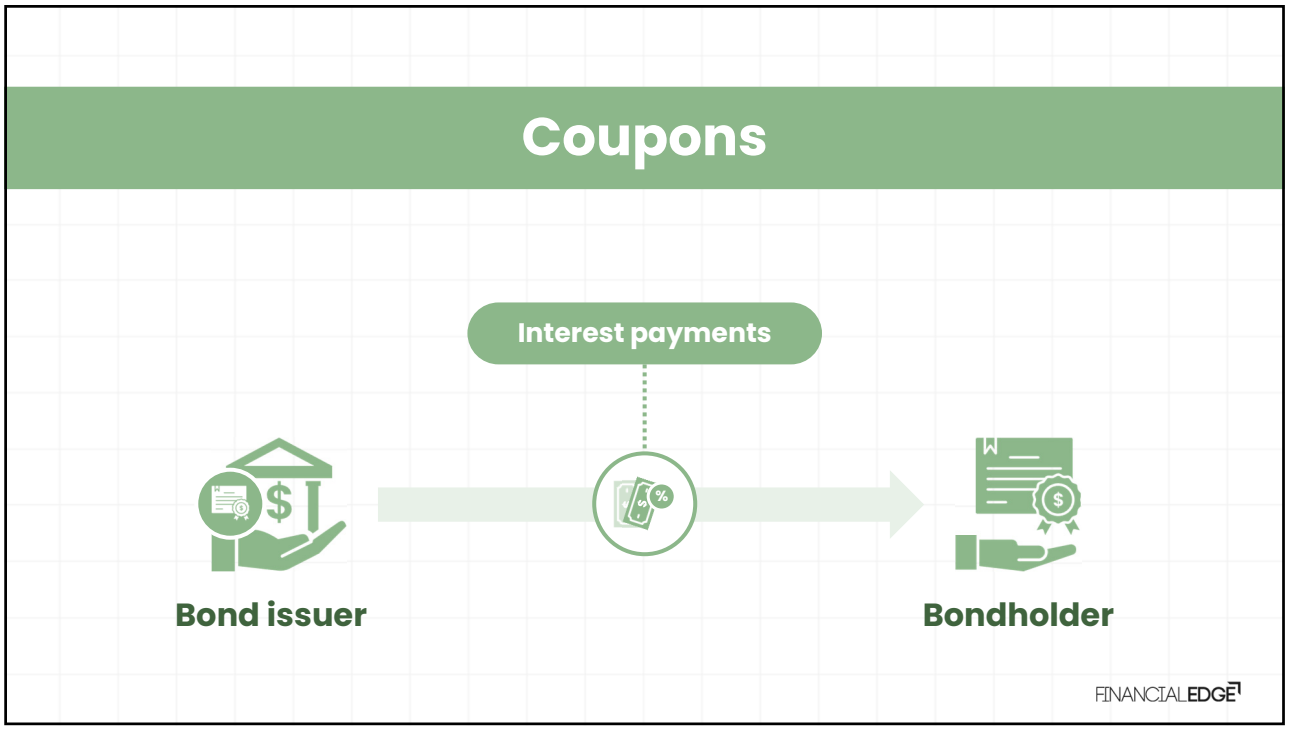

Yield to Maturity (YTM)

- Coupons
- Reinvestment returns
- Bond price

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Reinvestment returns

Potential returns earned if the **bondholder reinvests** the **coupon payments** at the **same rate** as the **bond's YTM until maturity**

✓ Coupon payments	✗ Bond's notional (principal) amount

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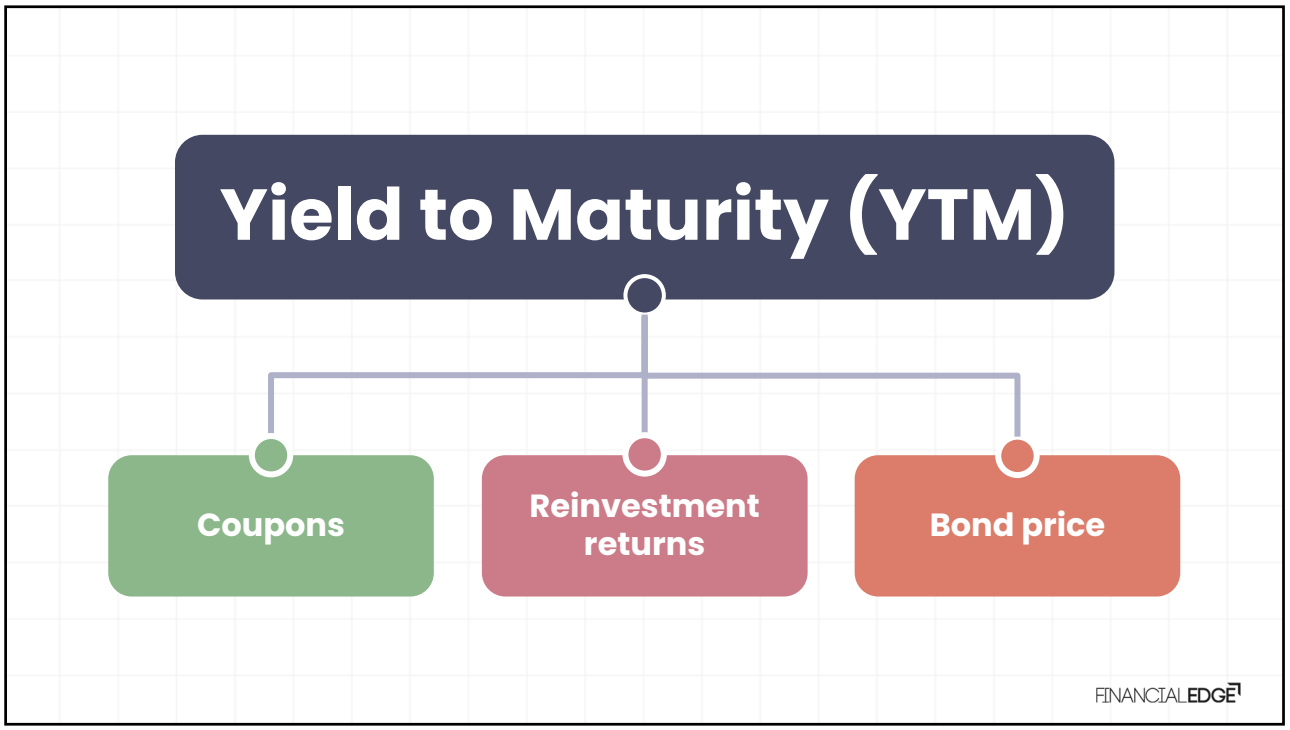

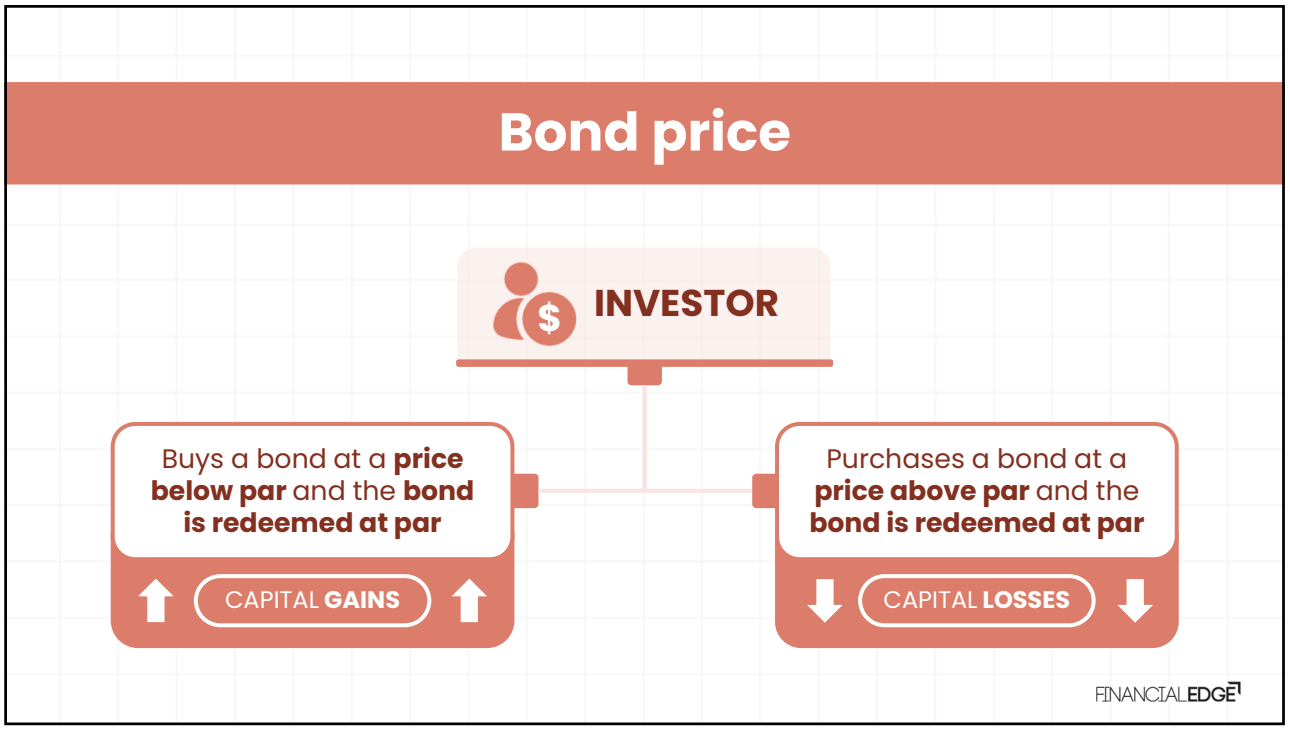

The Bond Price/Yield Relationship

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Bond Price

CLOSE LINK

Bond Yield

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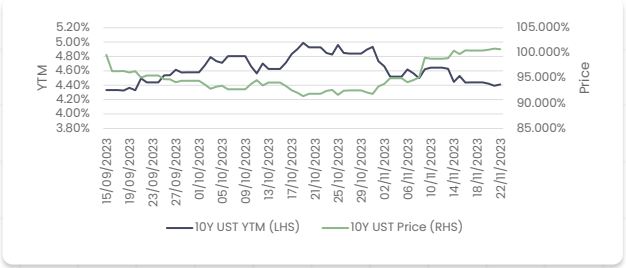
Bond Price/Bond Yield Relationship



Bond yield reflects...

- Coupon payments
- Capital gains or losses
- Redemption payment

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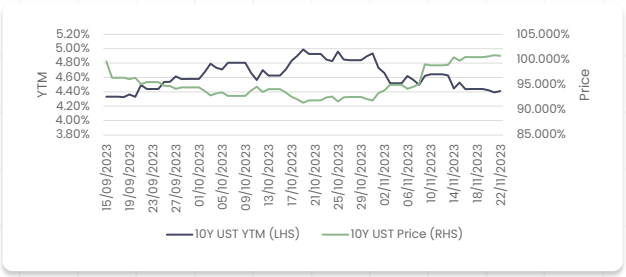
Bond Price/Bond Yield Relationship



Price of a bond **rises**

Yield of the bond **falls**

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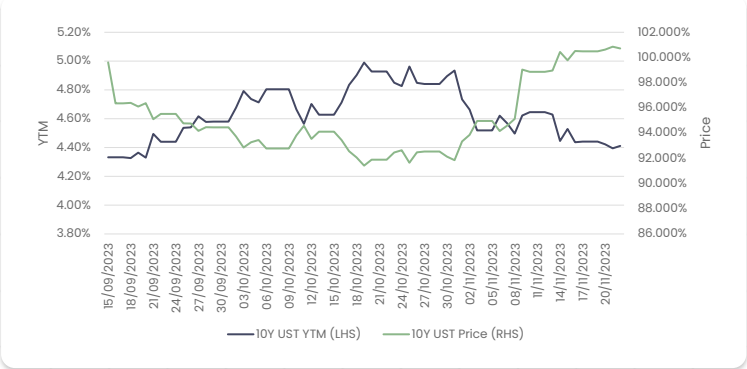
10-year bond with a 4% fixed coupon at a price of 92% of its face value

4% coupon annually

Buying the bond at 92%

100% at maturity



Price of a bond **rises**

VICE VERSA

Yield of the bond **falls**

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Yield Curve

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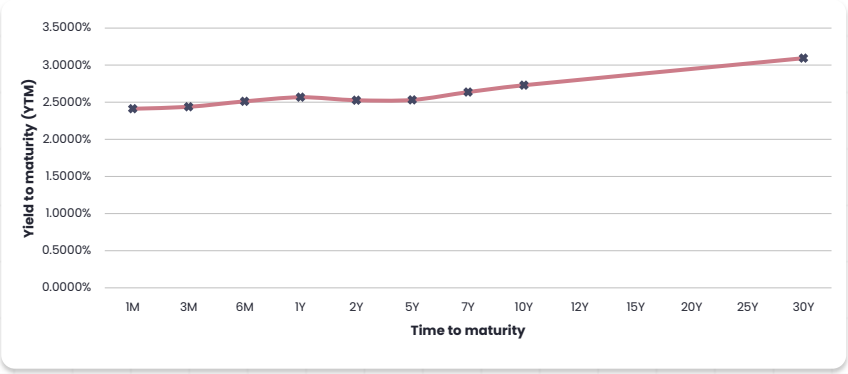
Issuers have **several bonds** with different **maturity dates outstanding**

A yield curve is a **graphical representation** of **bond yields** at **various maturities**, typically using YTM as the **yield metric**



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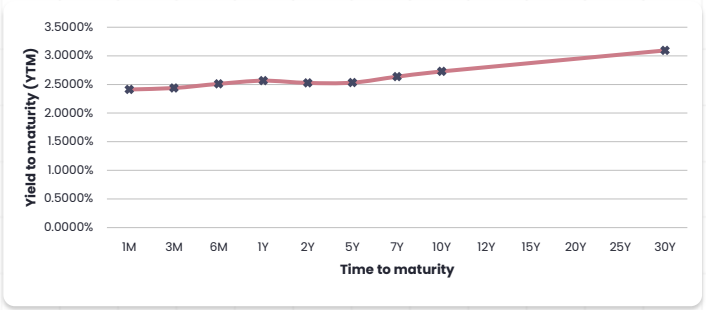

All **bonds** used must have the same **issuer** and **credit quality**

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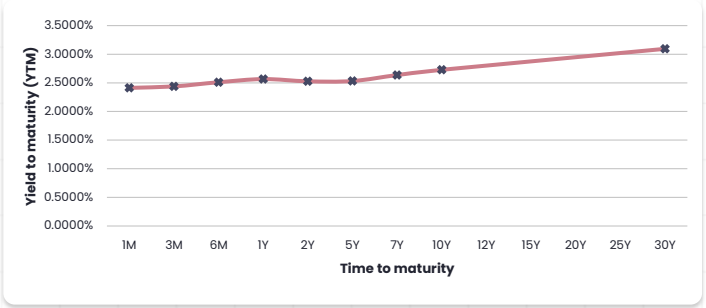

Credit quality refers to perceived ability of the issuer to meet **debt obligations**

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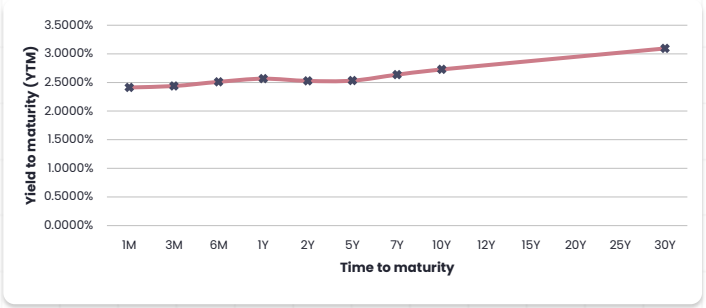

U.S. government debt

Highest credit quality

U.S. Treasuries → Not mixing with bonds from different issuers

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YTM Formula

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Dirty Price (P_d)

Clean Price (P_c)

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Dirty Price (P_d)

$$P_d = \sum_{t=1}^{n} \frac{c_t}{(1+YTM)^t} + \frac{FV}{(1+YTM)^n}$$

The **sum** of the **present values** of all the **bonds' cash flows,** discounted using the **yield to maturity (YTM)**

Represents the **current value of the bond**

The price that **must be paid by investors** when purchasing the bond

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Dirty Price (P_d) − **Accrued Interest** = **Clean Price (P_c)**

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Accrued Interest

The interest that has **accumulated on the bond** since the **last coupon payment**, up to the purchase date of the bond

Since **coupon payments** are made at **regular intervals** (e.g., semi-annually or annually)...

...a **bondholder earns interest** over time even though they only receive **payment at the set intervals**

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Accrued Interest

The interest that has **accumulated on the bond** since the **last coupon payment**, up to the purchase date of the bond

When a **bond is sold between these payment dates...**

...the **seller** is entitled to the **interest that accrued** during their ownership period

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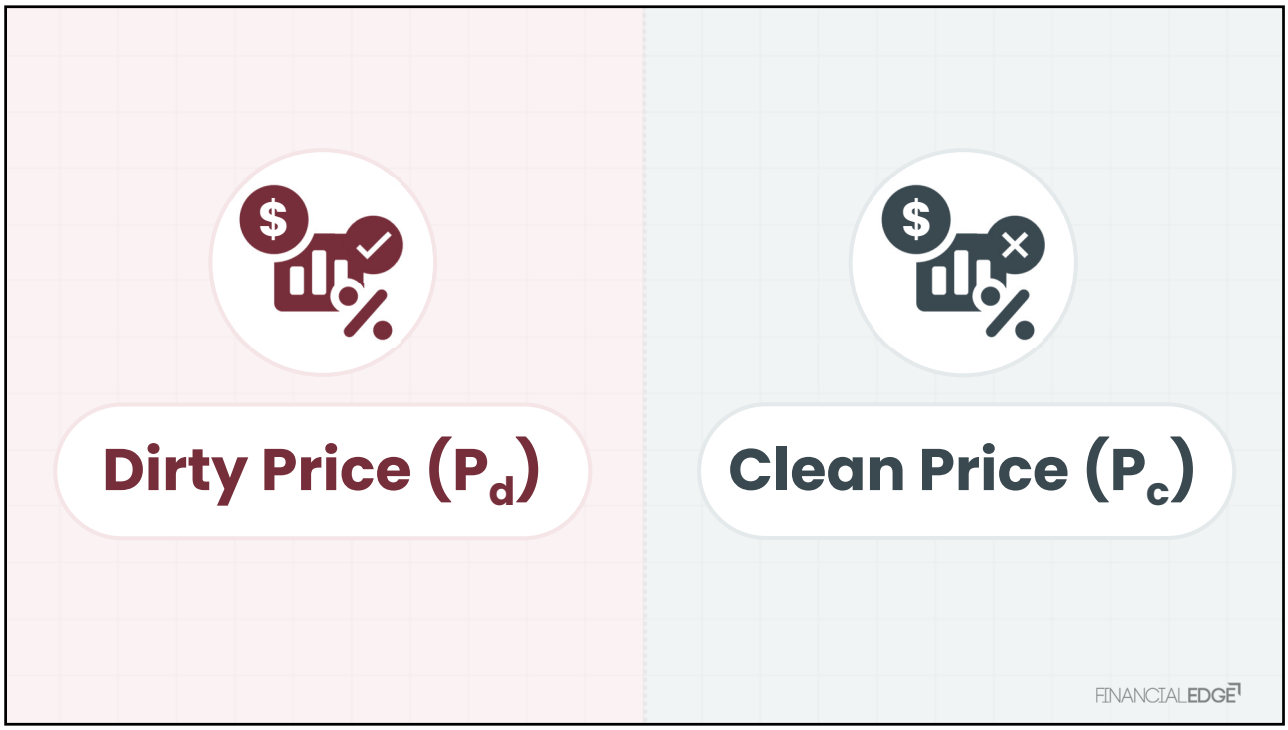

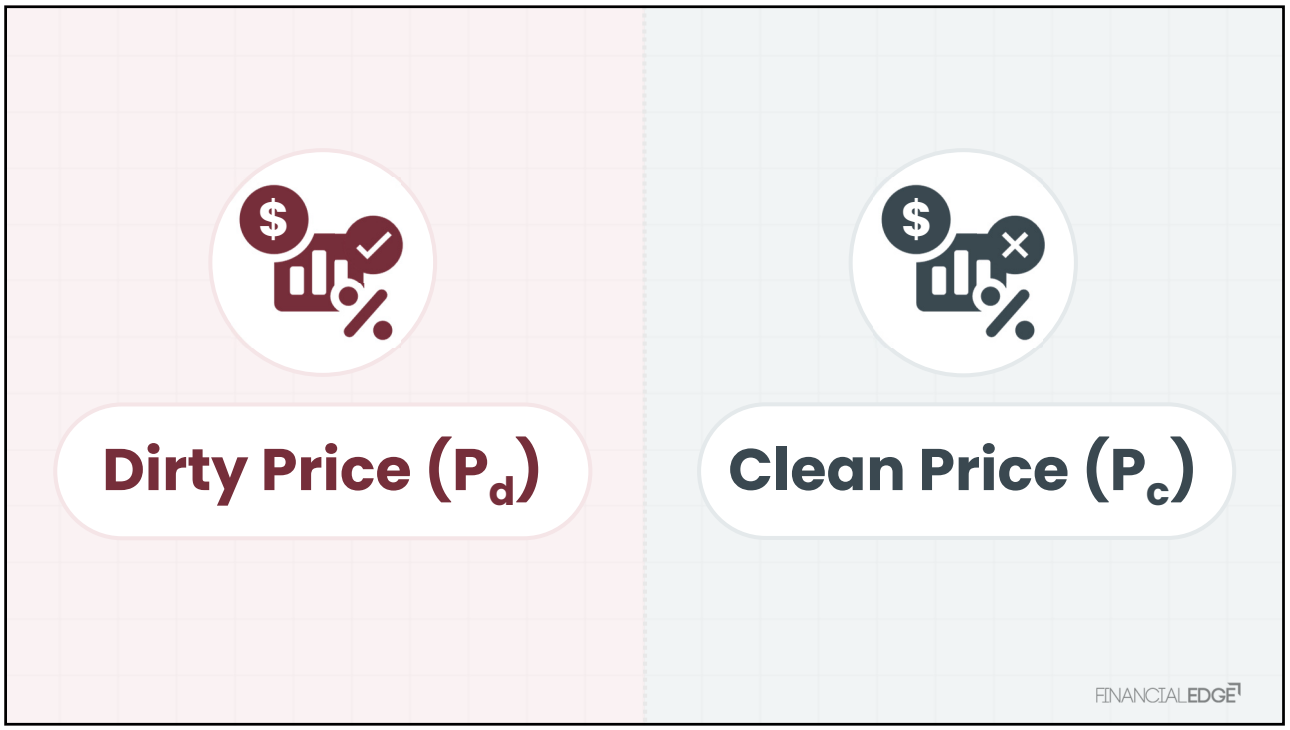

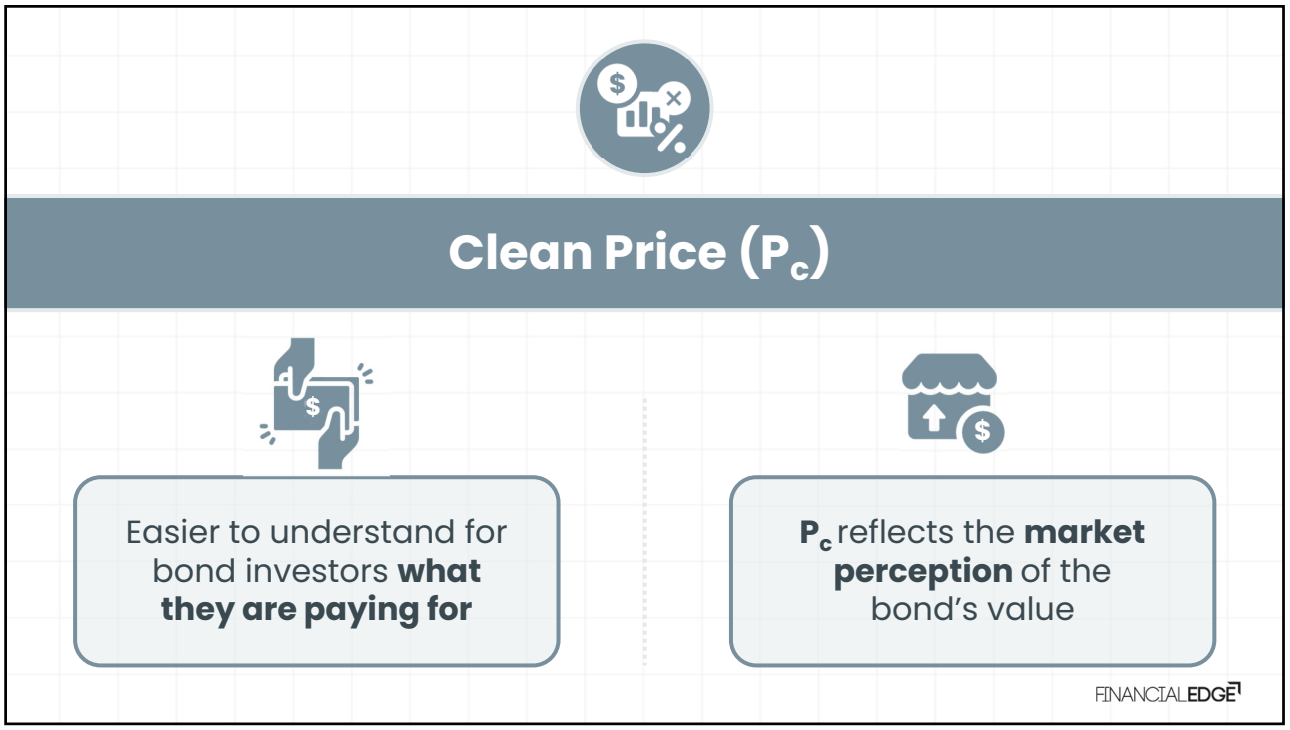

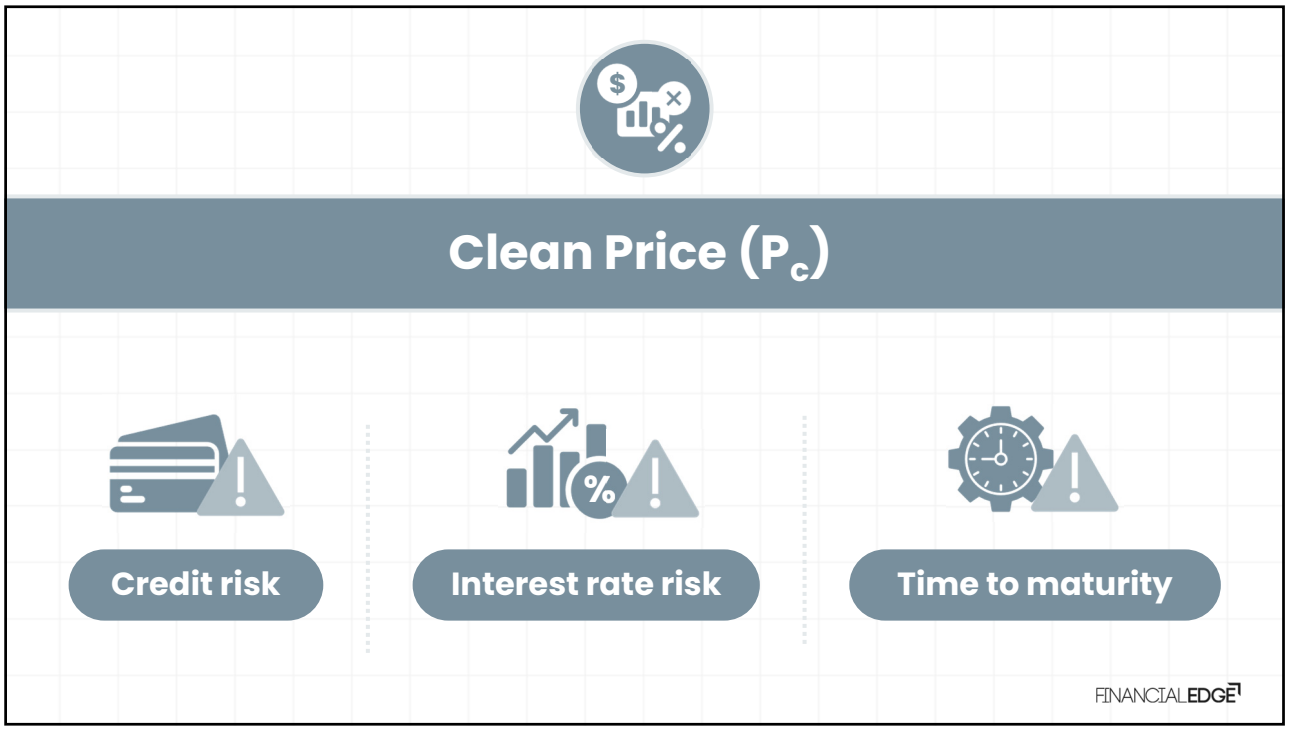

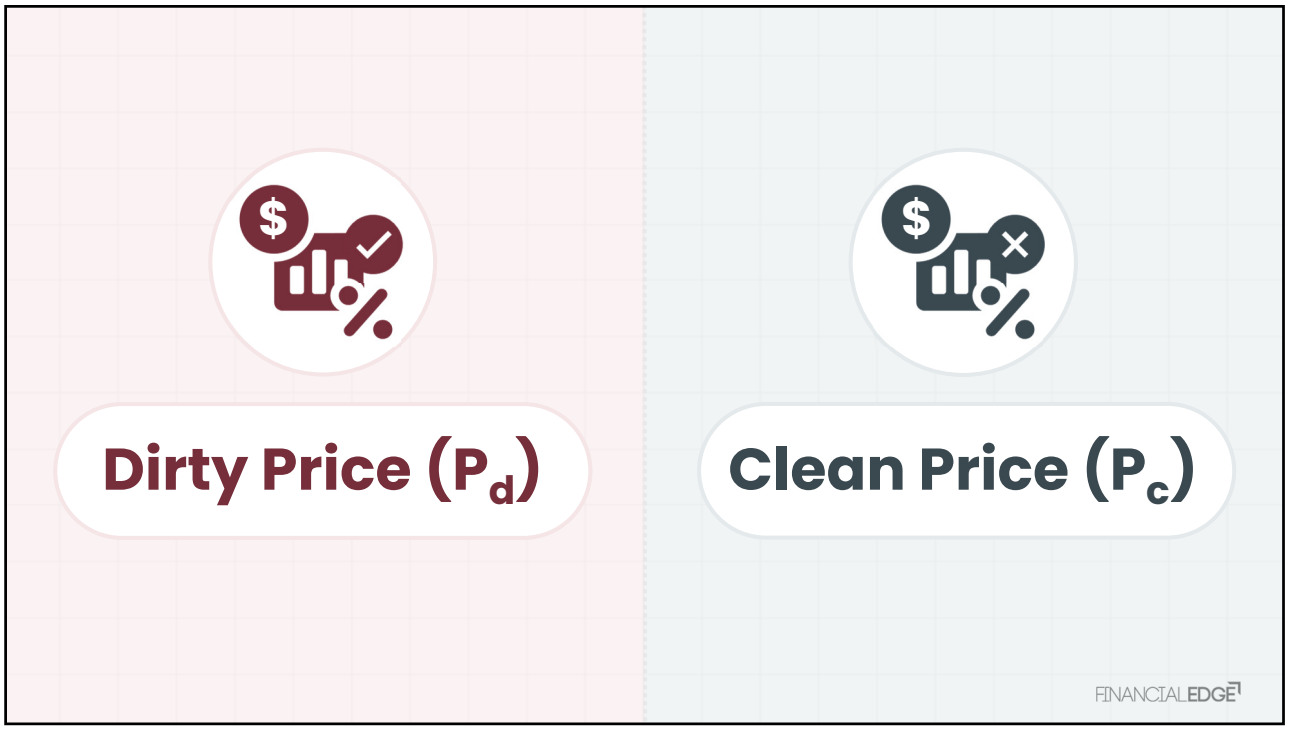

Dirty Price (P_d)

Bond price changes daily as interest accrues

Don't reflect changes in bond market valuation or its risk and return profile

Using clean prices, the market can **focus** on the **bond's** fundamental **value**

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Dirty vs. Clean Price

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Dirty vs. Clean Price Example

Year (t):	Cash flow:	PV:
1	2.4%	2.3431%
2	2.4%	2.2875%
3	2.4%	2.2332%
4	2.4%	2.1802%
5	102.4%	90.8164%
	Total:	99.8603%

5Y bond — **Annual coupon: 2.4%** — **YTM: 2.43%**

Yield to Maturity (YTM)

Sum of PVs = P_d = 99.8603%

Present Value (PV) Dirty Price(P_d)

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On the next business day...

Year (t):	Cash flow:	PV:
0.9973	2.4%	2.3432%
1.9973	2.4%	2.2876%
2.9973	2.4%	2.2334%
3.9973	2.4%	2.1804%
4.9973	102.4%	90.8223%
	Total:	99.8669%

5Y bond one day later — **Annual coupon: 2.4%** — **YTM: 2.43%**

Yield to Maturity (YTM)

Sum of PVs = P_d = 99.8669%

Present Value (PV) Dirty Price(P_d)

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	Total:	99.8669%

P_d includes 1 day of **accrued interest: 0.0066%**

2.4 x 1/365 = 0.0066%

$P_c = P_d$ – accrued interest = 99.8603%

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Dirty vs. Clean Price Characteristics

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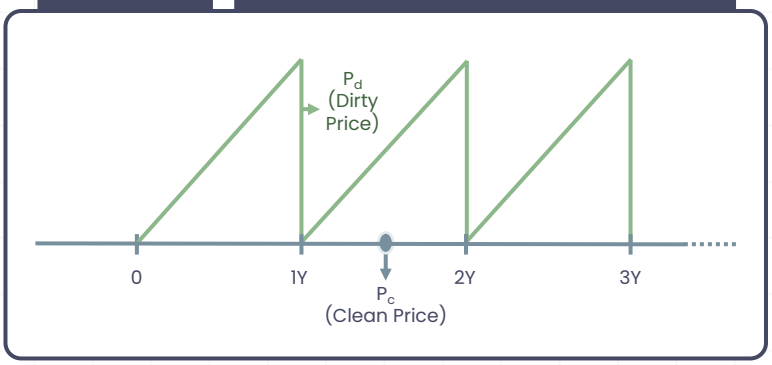
Assuming a **constant YTM over the life of the bond**, the development of clean and dirty prices of would compare as shown here:

5Y bond 2.4% **Clean vs Dirty Price** assuming constant YTM



Yield to Maturity (YTM)

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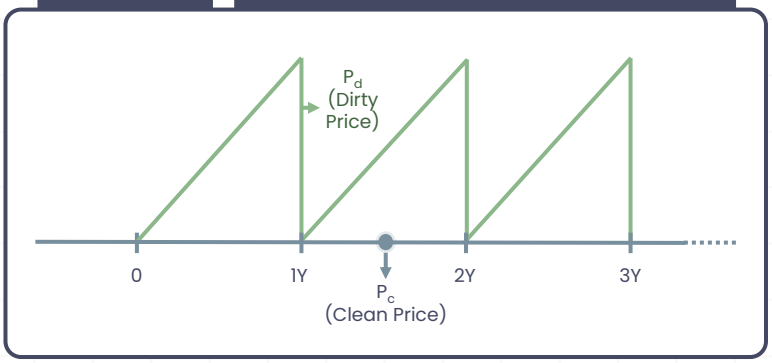
5Y bond 2.4% **Clean vs Dirty Price** assuming constant YTM



Clean Price

Remain relatively **stable**

Dirty Price

Follows a **saw tooth pattern**

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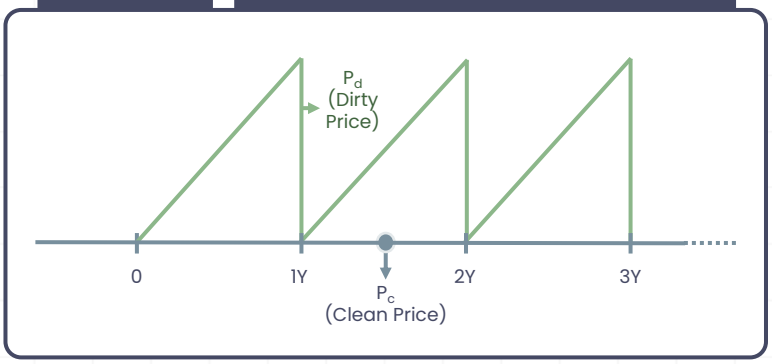
5Y bond 2.4% **Clean vs Dirty Price** assuming constant YTM



Dirty Price

Increases, reflecting the **accumulation of accrued interest**

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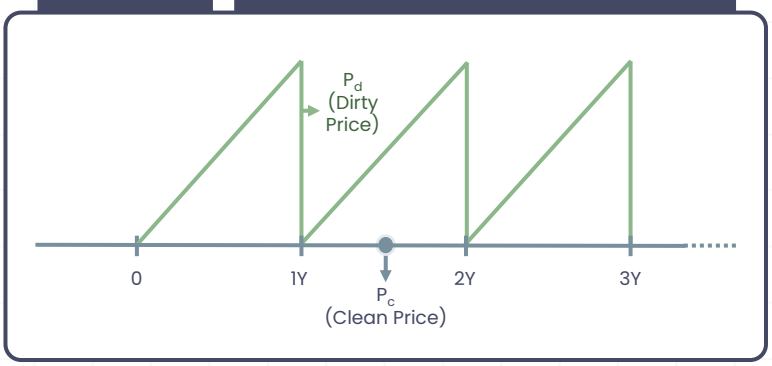
5Y bond 2.4% **Clean vs Dirty Price** assuming constant YTM



Coupon Payment Date

Bondholder receives the **coupon payment** (includes the accrued interest)

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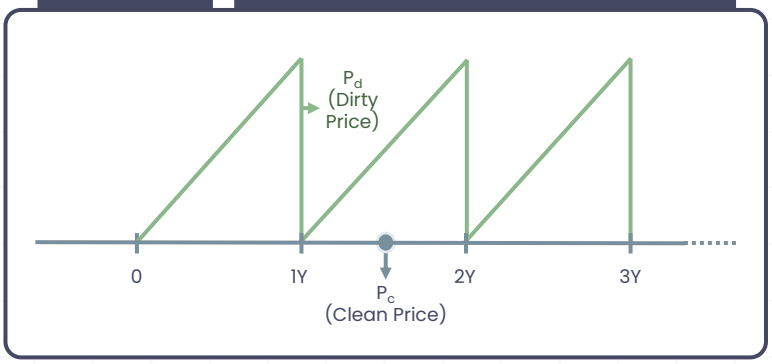
5Y bond 2.4% **Clean vs Dirty Price** assuming constant YTM



Coupon Payment Date

The **accrued interest resets to 0**, and the dirty price **drops back down** to the level of the clean price

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Fixed Coupon Bond Cash Flow Conventions

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Bond coupons play a vital role

Investor returns

Dirty Price (P_d)

Clean Price (P_c)

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How do bond coupons work?

What happens when the payment date of a coupon falls on a weekend?

How do we divide a 365-day year into two halves for a semi-annual paying bond?

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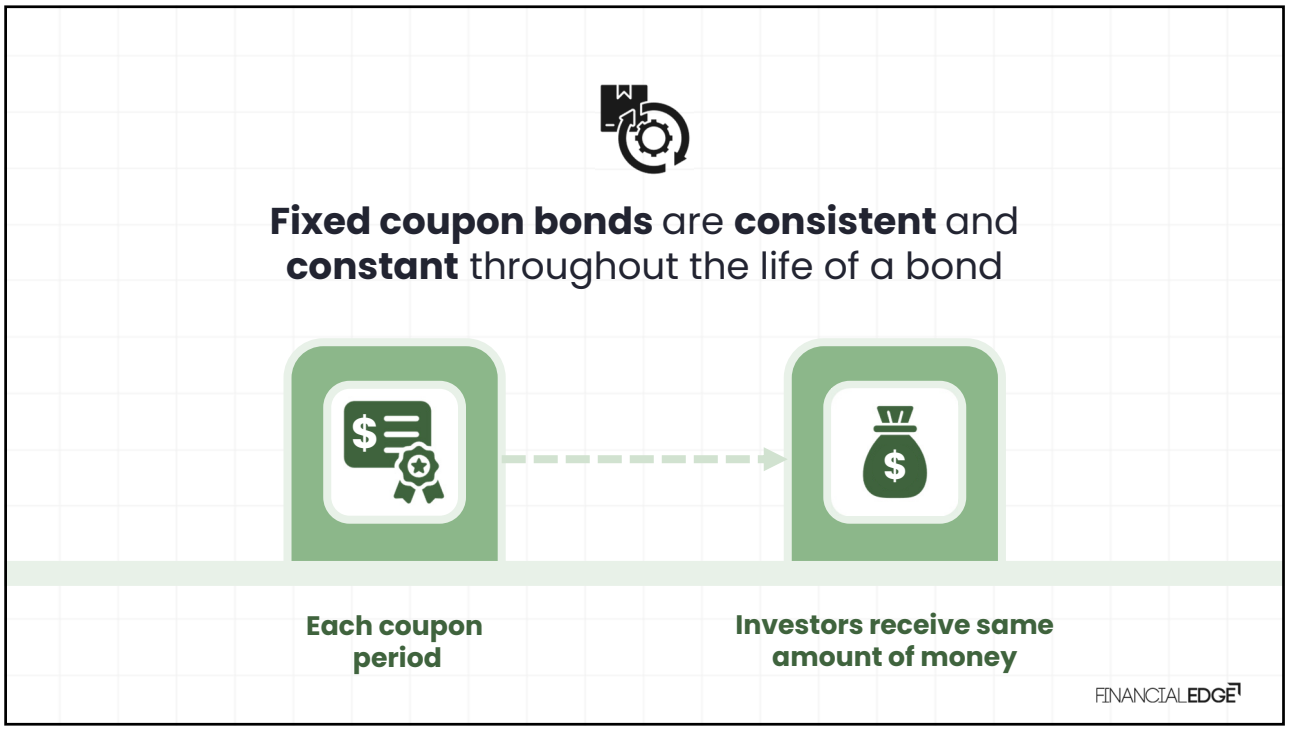
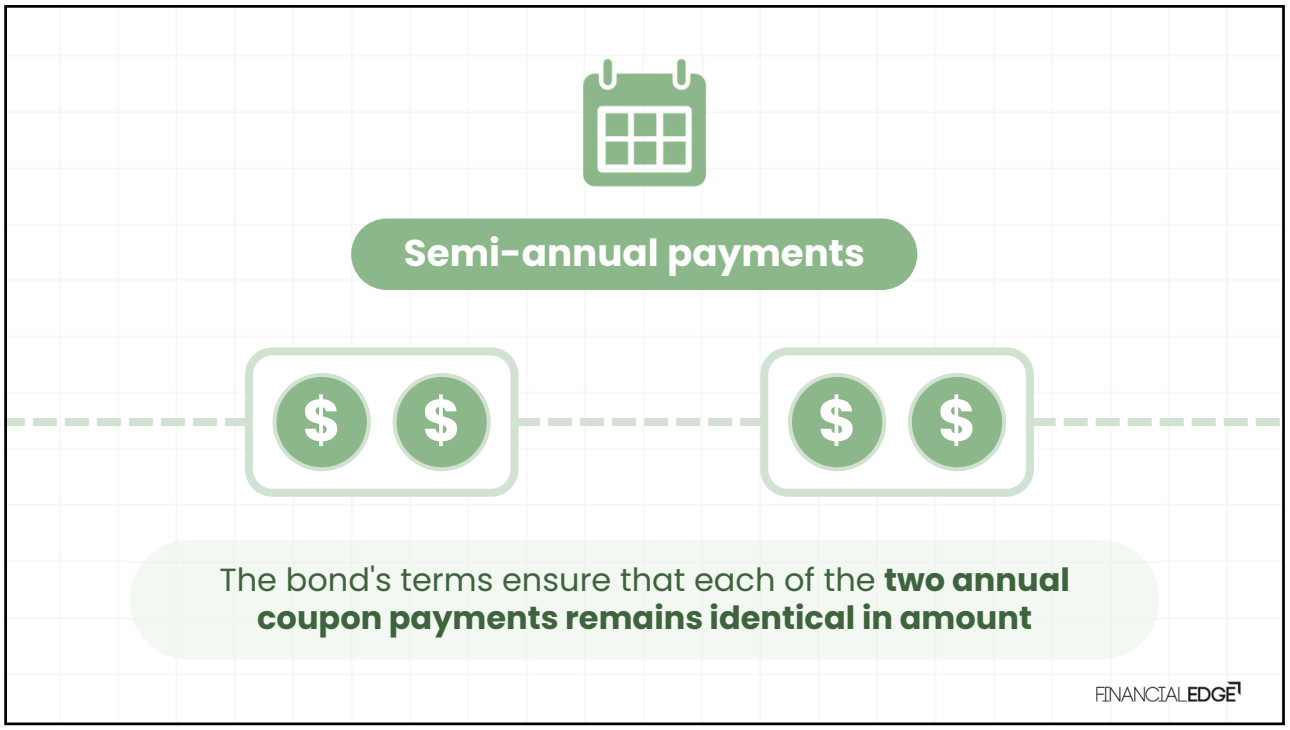
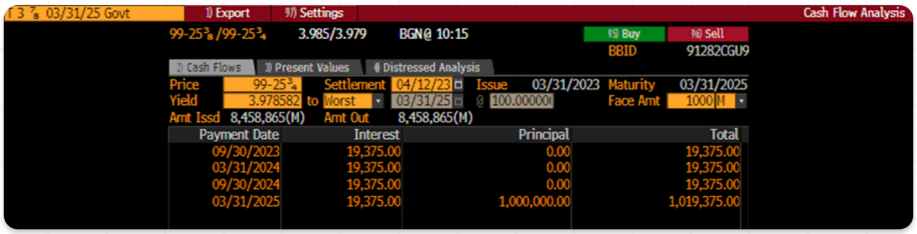




Cash flow example: 3.875% Treasury Mar 2025:



Payment Date	Interest	Principal	Total
09/30/2023	19,375.00	0.00	19,375.00
03/31/2024	19,375.00	0.00	19,375.00
09/30/2024	19,375.00	0.00	19,375.00
03/31/2025	19,375.00	1,000,000.00	1,019,375.00

Investors receive two payments of **$19,375.00 each year**

Consistency in **modeling** and **calculations**

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Carry and Net-Carry

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1

Carry

Refers to the running **interest income** accrued on the bond, providing a steady **stream of income**

2

Roll-Down

Reflects the change in a **bond's price** as it approaches **maturity** and the applicable **yield changes**

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Carry

The accrued interest a **bond generates**

Investor buys a **U.S. Treasury bond** with a **5% coupon**

Earn interest equivalent to **5%** annually, accruing daily

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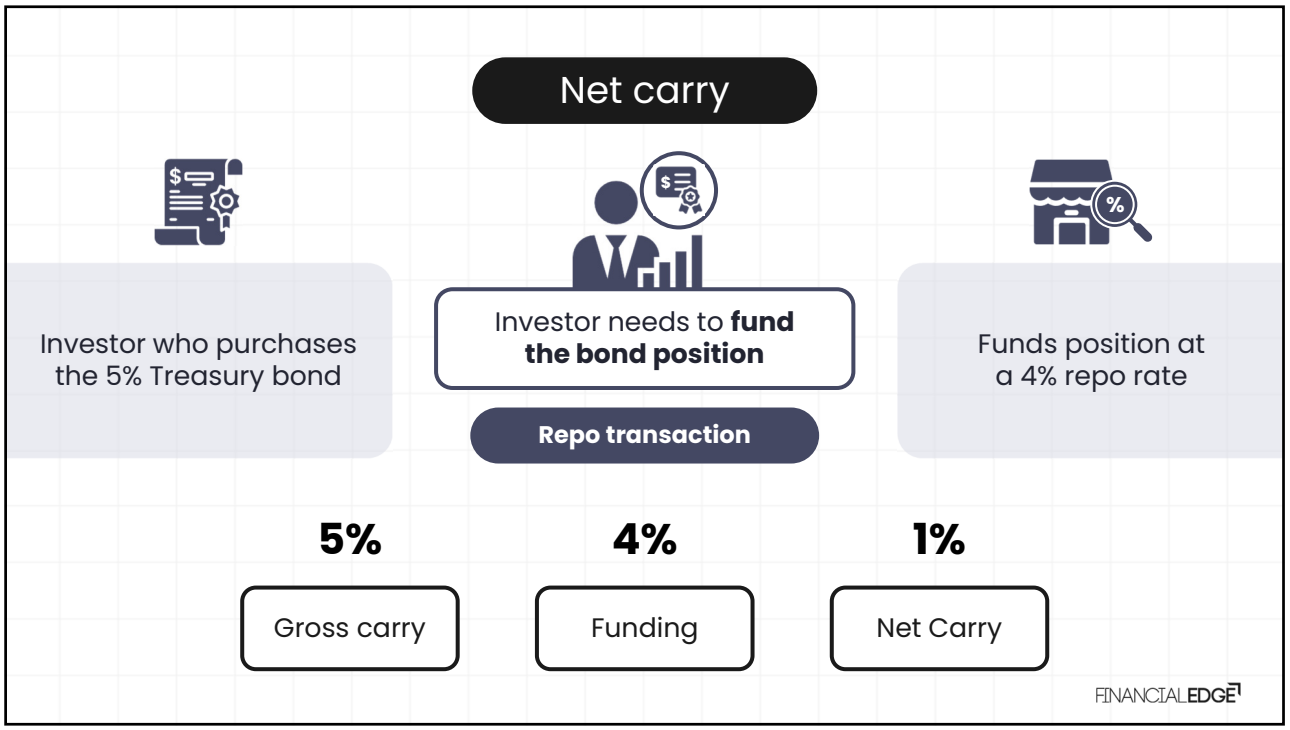

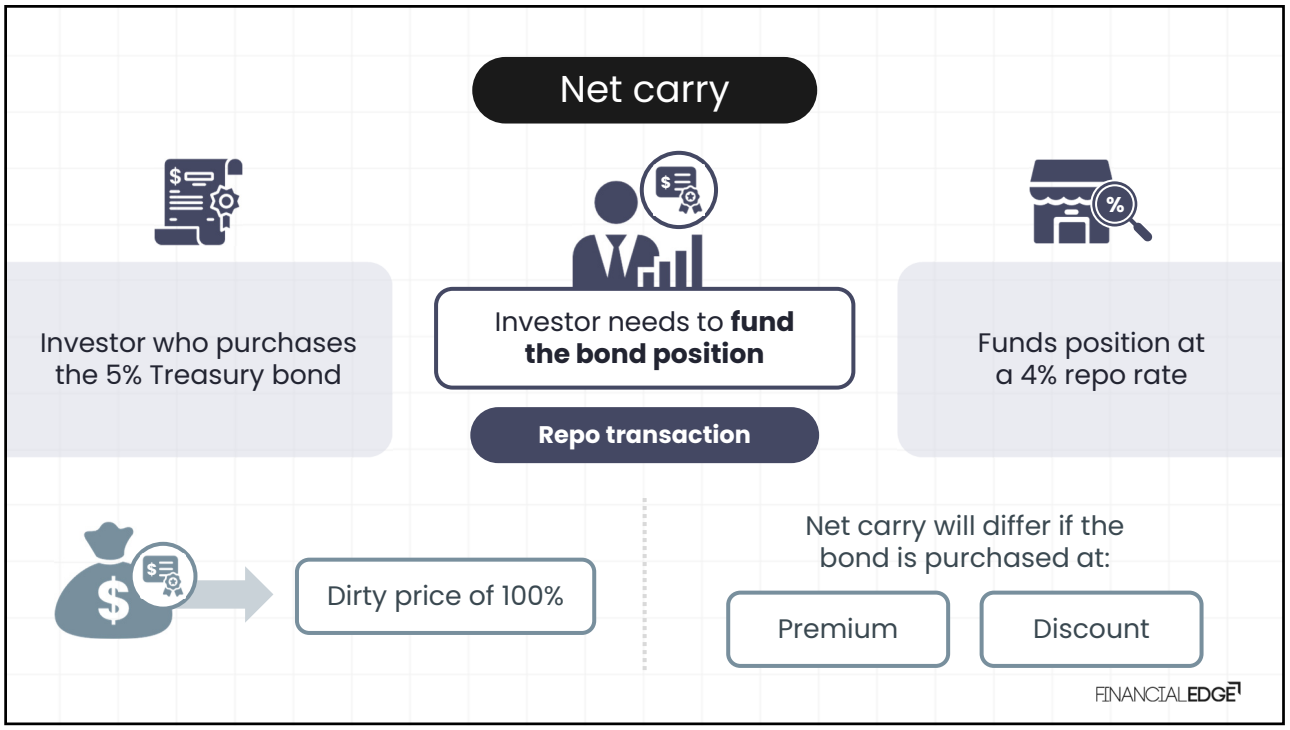

Roll-Down

FINANCIALEDGE

1

Carry

This refers to the running **interest income** accrued on the bond, providing a steady **stream of income**

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Roll-Down

This reflects the change in a **bond's price** as it approaches **maturity** and the applicable **yield changes**

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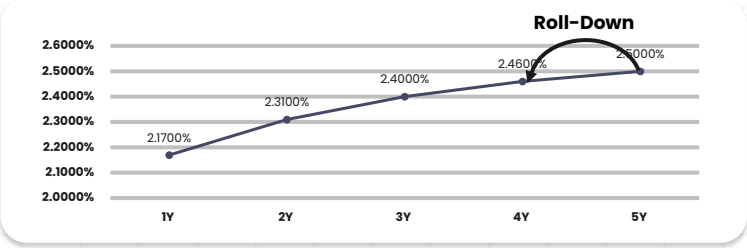
Roll-Down



In the case of a normal **upward-sloping yield curve** - a bond's price tends to **increase as it gets closer to maturity**, assuming the **yield curve remains unchanged**

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Roll-Down

Inverted Yield Curve

- Short-term yields are higher than long-term yields
- Roll-Down might not generate price gains but instead price declines
- Roll-Down is not guaranteed income or expense
- Yield curve changes – Impact how the bond's price changes

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Roll-Down

Pull-to-Par Effect

Bond's price will gradually converge toward its face value

As bond approaches its redemption date, its clean price will **move towards par**

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