Bond value and interest rate changes

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Plan

- I. Bonds and Risk: All Risk Is Not Equal
- II. Managing the relationship between bond value and interest rate changes:
- 1. Interest Rate Forward Structure (or Yield Curve)
- 2. Flexibility
- 3. Duration
- 4. Sensitivity (aka Interest Rate Risk)
- 5. Convexity

I. Bonds and Risk: All Risk Is Not Equal

Bonds are susceptible to a number of risks, including the following:

1. Interest-rate risk. Interest rates may rise or fall at any time, resulting in a decline or increase in a bond's value. Rising interest rates require that future cash flows have a higher rate of return. Since future cash flows are fixed in bonds, the principal value of the bond must be decreased to compensate for a higher required return.

2. Inflation risk. A rise or decline in inflation may result in an increase or decrease in the value of a bond. For most bonds, a higher rate of inflation results in a less valuable bond. The inverse of this situation is also true.

3. Company risk. The bond price may rise or decline because of problems with the company that is offering the bond. The better the future prospects for a company, the lower the required rate of return by investors and the higher the present value of a bond. The inverse of this situation is also true.

4. Financial risk. Whether or not a company is viewed as a financial risk has the potential to affect the performance of the company's bonds. Companies whose cash flows are sufficient to meet their financial obligations are considered less risky and can usually borrow money at lower rates of interest; hence, these companies may have lower interest costs and likely higher earnings. The inverse is also true.

5. Liquidity risk. Investors take the risk that they may not be able to find a buyer or seller for a bond when they need one. Sometimes liquidity is related to current market conditions as well as the company's financial statements.

6. Political or regulatory risk. Unanticipated changes in the tax or legal environment may have an impact on a company. Since taxes and the legal environment affect the outlook for a company, any regulatory changes that improve a company's long-term prospects will generally result in a higher price for that company's bonds. The inverse situation is also true.

7. Exchange-rate risk. Changes in exchange rates may affect profitability for international companies. As exchange rates strengthen, the cost of domestically produced goods that are sold overseas increases. The inverse is also true

II. Managing the relationship between bond value and interest rate changes:

managing how **bond prices react to interest rate changes**, using tools like **interest rate forward structure, flexibility, duration, sensitivity, and convexity**. Here's a clear explanation of each term and how it fits into the big picture.

When **interest rates change**, **bond values go up or down**. Investors and portfolio managers use several tools and concepts to **manage and reduce the risks** caused by those changes.

1. Interest Rate Forward Structure (or Yield Curve)

A **forward structure** (also called the **term structure of interest rates**) is a **graph** that shows how interest rates vary with different **maturities** (e.g., 1-year, 5-year, 10-year).

Types of Yield Curves:

- **Normal Curve**: Long-term rates > short-term rates (economic growth expected)
- **Inverted Curve**: Long-term rates < short-term rates (recession warning)
- **Flat Curve**: Similar rates across all maturities (uncertainty)

Why it matters:

- Helps investors **predict future interest rates**
- A **steep yield curve** means long-term rates are expected to rise
- A **flat or inverted curve** suggests uncertainty or economic slowdown

Managers use this structure to decide whether to invest in **short-term or long-term bonds**, based on where rates are headed.

Example:

If the curve is **steep upward**, it means future rates are expected to **rise**. You might avoid long-term bonds now because their prices will drop when rates go up.

2. Flexibility

Flexibility refers to how easily a bond portfolio can be adjusted to **respond to interest rate changes**.

Flexibility is the **ability to quickly adjust a bond portfolio** in response to interest rate changes, economic conditions, or investor needs.

How it's used:

- Managers may choose **floating-rate bonds**, short-term bonds, or derivatives for **flexible adjustment**
- Being flexible helps reduce risk when rates shift unexpectedly

A flexible portfolio = better control over price volatility

Examples of Flexible Tools:

- **Short-term bonds**: Mature quickly, so you can reinvest sooner at better rates
- **Floating-rate bonds**: Their coupon adjusts with interest rates, reducing risk
- **Derivatives**: Like interest rate swaps or futures, used to hedge against rate changes

3. Duration

Duration measures **how sensitive a bond's price is to interest rate changes**. It estimates the percentage change in a bond's price for a 1% change in interest rates. It also gives a rough estimate of how long it takes to recover your investment.

- **Higher duration = More sensitive to rate changes**
- **Lower duration = Less price movement when rates change**

Why it matters:

Duration helps investors **match the risk of a bond to their investment time frame**. It's also a core tool for **immunizing portfolios** against rate changes.

Types:

- **Macaulay Duration**: calculates the weighted average time before a bondholder would receive the bond's cash flows.
- **Modified Duration**: Measures **% change in bond price** per 1% change in interest rate

Managers often **match portfolio duration with investment goals** or adjust it based on interest rate forecasts.

Example:

If a bond has a **modified duration of 6** and interest rates rise by 1% → bond price will fall by **approximately 6%**.

4. Sensitivity (aka Interest Rate Risk)

This is about **how much the bond's price changes** when interest rates move.

- If a bond is **highly sensitive**, a small rate increase causes a **big drop in price**
- Longer-term bonds and low-coupon bonds are **more sensitive**

Sensitivity is mostly measured using **duration** and **convexity** (see next section).

Why it matters:

Understanding sensitivity helps investors build **more stable portfolios** by choosing bonds that align with their risk tolerance.

Key Factors Affecting Sensitivity:

- **Maturity**: Longer-term bonds = more sensitive
- **Coupon Rate**: Lower coupons = more sensitive
- **Initial Yield**: Bonds with lower initial yields are more sensitive

Example:

A **30-year zero-coupon bond** is **highly sensitive** — even a small rate change causes big price swings.
A **2-year high-coupon bond** is **less sensitive**.

5. Convexity

Convexity measures the **curvature** in the price-yield relationship of a bond.

- It tells you how the **rate of change** in price changes as rates move
- **Duration assumes a straight line**, but real bond prices follow a **curve**

Why it matters:

- **Higher convexity** = bond prices rise more when rates fall and fall less when rates rise (this is good!)
- Helps improve **accuracy in bond valuation**, especially with big interest rate shifts

Portfolio managers **prefer high convexity** because it cushions against rate increases.

Positive Convexity:

- When rates fall → prices rise **more**
- When rates rise → prices fall **less**

Why it matters:

- **High convexity = less risk + better upside**
- Especially important for large interest rate changes or **long-term bonds**

Example:

Two bonds may have the same duration, but the one with higher convexity will lose **less value** if rates rise and **gain more** if rates fall.

How It All Ties Together

Concept	Role in Managing Bond Value & Rate Changes
Interest Rate Forward Structure	Helps forecast future rate trends
Flexibility	Enables quick adaptation to changing markets
Duration	Measures how much value changes with small rate shifts
Sensitivity	Shows how risky the bond is to rate changes
Convexity	Improves price estimates and helps protect against sharp moves

Summary:

Managing bond valuation under interest rate changes means:

- **Predicting rate shifts** with the yield curve (forward structure)
- **Staying adaptable** with flexible tools
- **Measuring exposure** through duration and sensitivity
- **Fine-tuning risk and reward** using convexity

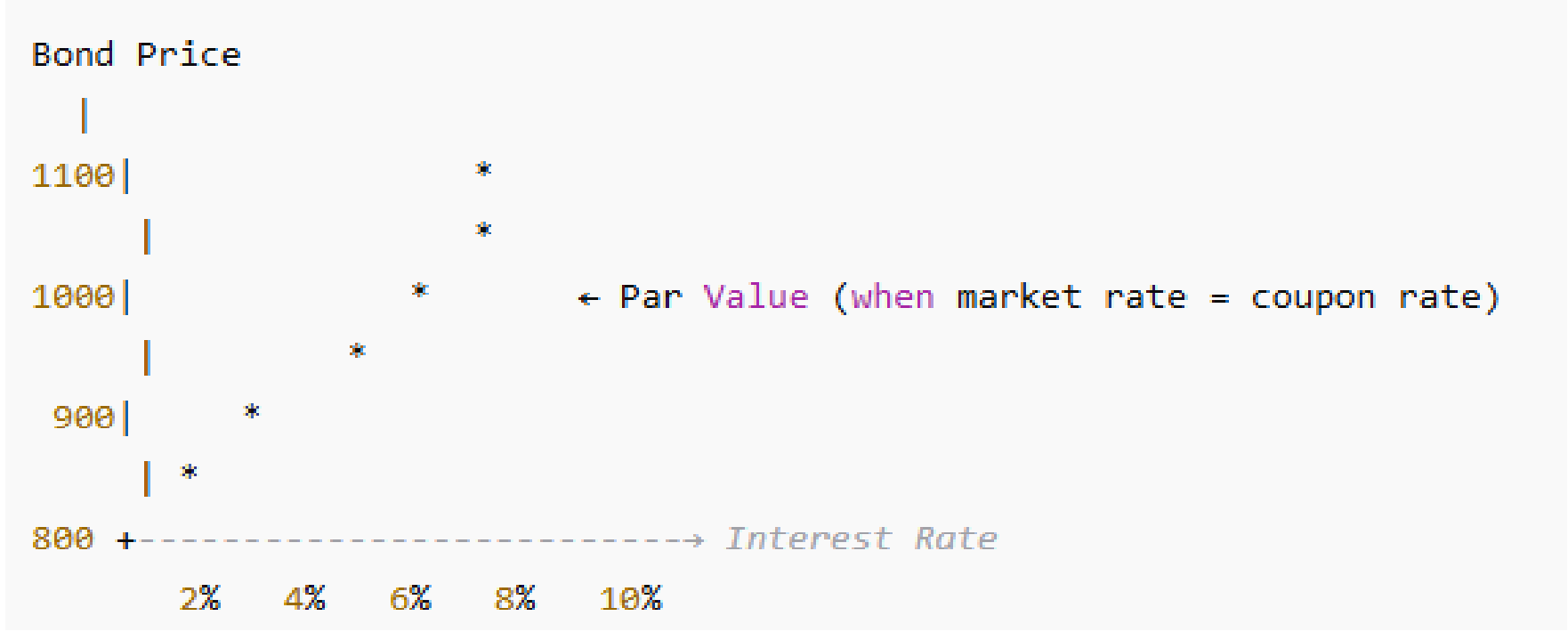
These tools allow investors to make smarter, safer decisions in both stable and volatile markets.

To **manage the impact of interest rate changes on bonds**, investors:

- Study the **yield curve** (forward structure)
- Build in **flexibility** to respond to market moves
- Measure **duration and sensitivity** to control risk
- Use **convexity** to enhance accuracy and protection

Simple Chart: Bond Price vs. Interest Rate

Here's how **bond prices and interest rates** typically behave (assuming all else equal):



Interpretation:

- When **interest rates fall** → bond prices **rise**
- When **interest rates rise** → bond prices **fall**

The curve is **not a straight line** — it curves **gently**. That's due to **convexity**.

Real-Life Example: Two Bonds

Let’s compare Bond A and Bond B:

Feature	Bond A	Bond B
Maturity	10 years	2 years
Coupon Rate	5%	5%
Current Market Rate	4%	4%
Duration	~8 years	~1.9 years
Convexity	High	Low
Sensitivity	High (price moves a lot)	Low (price is stable)

What happens if interest rates increase to 6%?

- **Bond A** drops significantly in price — it’s long-term and more sensitive.
- **Bond B** drops just a little — it’s short-term and less sensitive.

So if you're worried about interest rates rising, **Bond B is safer**.

Real-Life Application: Pension Funds

Scenario:

A pension fund needs to **pay retirees over 30 years**. It invests in bonds to meet those payments.

How it applies:

- It looks at the **interest rate forward curve** to forecast rates
- Uses **duration matching** to ensure bonds mature when cash is needed
- Chooses **high-convexity bonds** to protect against rate volatility
- Keeps some **short-term, flexible bonds** to adapt to rate changes

This way, the fund **manages risk**, protects principal, and meets obligations smoothly — no matter how rates move.

Tool	Visualized As	Real-Life Example
Yield Curve	A curve showing short to long-term rates	Used to pick maturities
Duration	Sensitivity meter	Used to match liabilities
Sensitivity	Bond's reaction to rate change	Important in rising rate environments
Convexity	Curve shape correction	Adds safety in volatile markets
Flexibility	Quick adjustments	Short-term bonds or floating rates