COURSE: INVESTMENTS |CHAPTER 11

MANAGING BOND PORTFOLIOS

Dr Abenet Yohannes, Ph.D.

Chapter Purpose

This chapter moves from valuing individual bonds to managing portfolios of bonds.

Risk
Interest-rate risk, price sensitivity

Measures
Duration, modified duration, convexity

Liability tools
Immunization, cash-flow matching, ladders

Strategies
Passive, active, yield-curve, swaps, credit

Learning Objectives

By the end of this chapter, students should be able to:

- Explain the objectives of bond portfolio management and interest-rate risk
- Identify the factors affecting bond-price sensitivity
- Explain Macaulay duration, modified duration and portfolio duration
- Estimate bond-price changes using duration, and explain convexity
- Explain immunization, cash-flow matching and bond laddering
- Compare passive and active strategies, including yield-curve strategies and bond swaps
- Apply bond portfolio strategies to investor objectives

SECTION I — WHY MANAGE BOND PORTFOLIOS?

Objectives, investors and risks

Dr Abenet Yohannes, Ph.D.

What Is Bond Portfolio Management?

The process of selecting and managing fixed-income securities to achieve objectives relating to:

- Income
- Capital preservation
- Liquidity
- Risk management
- Liability funding
- Total return

> ***Key question: what combination of bonds best meets the investor's objectives?***

Who Manages Bond Portfolios?

Bond portfolios are central to a wide range of investors:

Institutions
Pension funds, insurance companies, banks

Funds
Mutual funds, endowment funds

Others
Governments, corporations, individuals

Different Investors — Different Objectives

Retiree
May prioritize stable income

Pension fund
Must fund future pension payments

Bank
Liquidity and asset-liability management

Bond fund
Seeks to outperform a benchmark

There is no single "best" bond portfolio for everyone.

Major Bond Portfolio Risks

- Interest-rate risk
- Reinvestment risk
- Credit / default risk
- Liquidity risk
- Inflation risk
- Call risk
- Currency risk

This chapter focuses on INTEREST-RATE RISK

SECTION II — INTEREST-RATE RISK

The bond seesaw

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Review — The Bond Seesaw

Remember Chapter 10: bond prices and market yields move in opposite directions.

Market yield ↑ → Bond price ↓

Market yield ↓ → Bond price ↑

This inverse relationship creates interest-rate risk.

Why Bond Prices Change

Suppose your existing bond pays 5%. Then new comparable bonds begin paying 10%.

Investors will not want to pay the old price for your 5% bond.

Its price must generally FALL to become competitive.

Not All Bonds React Equally

Suppose interest rates increase by 1%. Will every bond decline by the same percentage? No.

Price sensitivity depends on factors such as:

- Maturity
- Coupon rate
- Current yield
- Timing of cash flows
- Embedded options

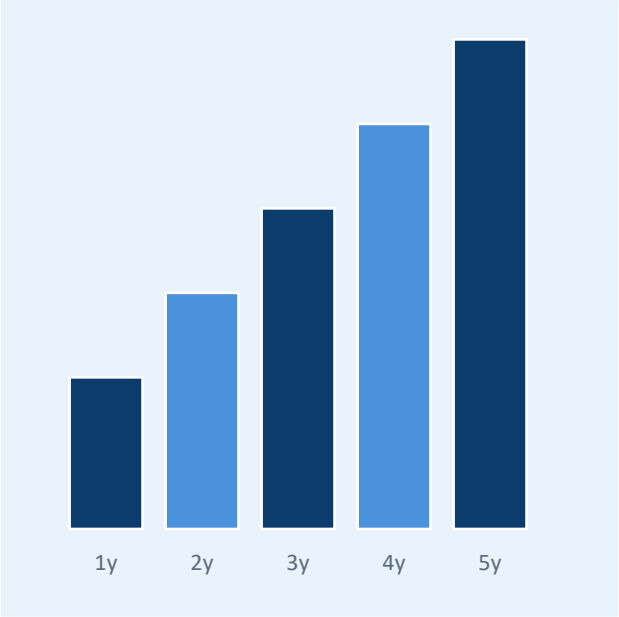
SECTION III — MATURITY AND PRICE SENSITIVITY

Maturity Matters

Longer maturity
Greater interest-rate sensitivity

Shorter maturity
Lower interest-rate sensitivity

Other things equal — compare a 2-year bond with a 30-year bond.



— Why Long Bonds Move More

Bond A
Money returned next year

Bond B
Money returned 20 years from now

A change in the discount rate has a much larger effect on distant cash flows.

Long-term bonds generally react more strongly to interest-rate changes.

Coupon Rate Also Matters

Lower coupon
Greater price sensitivity

Higher coupon
Lower price sensitivity

Why? Higher-coupon bonds return more cash to the investor earlier, shortening the effective timing of cash flows.

Zero-Coupon Bonds

A zero-coupon bond provides no intermediate coupons. Most of its value comes from one payment at maturity.

One payment. At maturity.

Therefore, for a given maturity, zero-coupon bonds generally have relatively high interest-rate sensitivity.

SECTION IV — DURATION

Measuring the timing of cash flows

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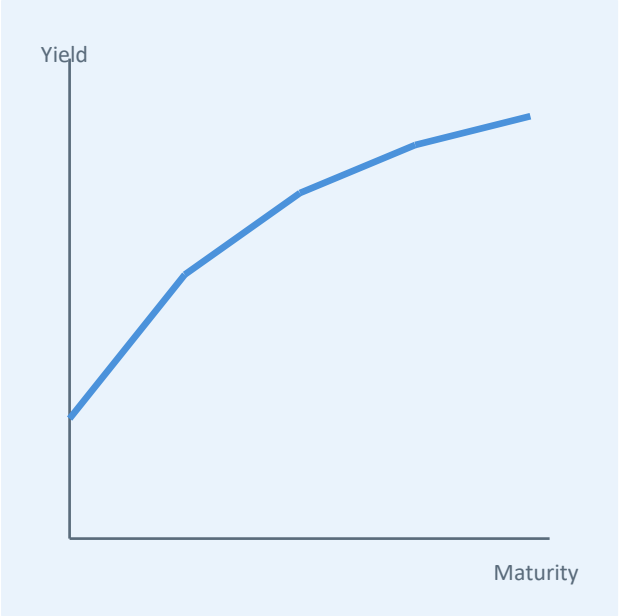
What Is Duration?

Duration is one of the most important concepts in fixed-income portfolio management.

Timing
The timing of a bond's cash flows

Sensitivity
Price sensitivity to yield changes



— Duration

Imagine a bond gives you money at different times — some next year, some in two years, some in five years.

> ***On a present-value-weighted basis, how long do I wait to receive the bond's cash flows?***

Macaulay Duration

Macaulay duration is the present-value-weighted average time until a bond's cash flows are received.

$$D_M = \Sigma [t \times PV(CF_t)] \div \text{Bond Price}$$

Each date is weighted by the present value of the cash flow received on that date.

Duration Uses Present-Value Weights

Suppose a bond generates:

- ETB 100 in Year 1
- ETB 100 in Year 2
- ETB 1,100 in Year 3

We do not simply average 1, 2 and 3. Instead, each time period receives a weight based on the present value of its cash flow.

Duration vs Maturity

Maturity
Time until the final contractual payment

Duration
Weighted-average timing of all cash flows

Duration and maturity are related — but they are not the same thing.

Zero-Coupon Bond Duration

For a conventional zero-coupon bond, all cash flow occurs at maturity. Therefore:

Macaulay Duration = Maturity

Example: a 10-year zero-coupon bond has a Macaulay duration of 10 years.

Coupon Bond Duration

For a conventional coupon bond, some cash is received before maturity. Therefore, typically:

Duration < Maturity

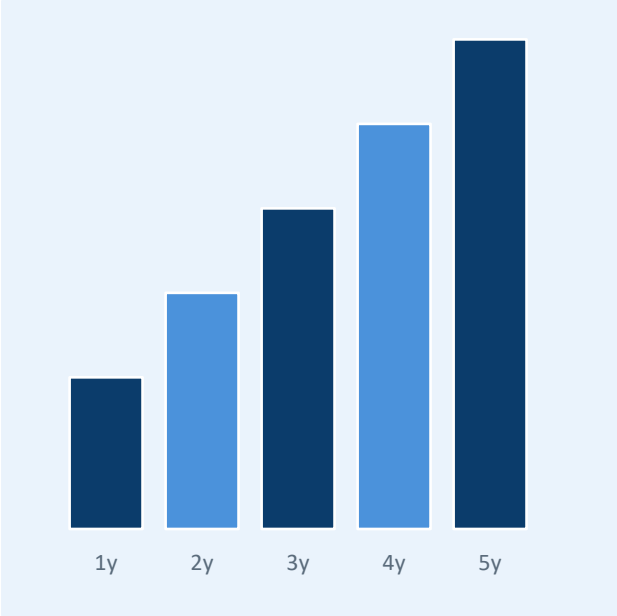
Example: a 10-year coupon bond may have a duration substantially below 10 years.

SECTION V — WHAT DETERMINES DURATION?

Duration and Maturity

Maturity ↑ → Duration ↑

Longer-maturity bonds normally have greater duration, other things equal, because a larger share of value sits in distant cash flows.



Duration and Coupon

Coupon rate ↑ → Duration ↓

because more cash is received earlier.

Coupon rate ↓ → Duration ↑

Duration and Yield

Other things equal, for conventional bonds:

Yield ↑ tends to Duration ↓

because distant cash flows receive lower present-value weights when discounted at a higher yield.

Summary — Duration Drivers

Factor	Typical effect on duration
Maturity ↑	Duration ↑
Coupon ↑	Duration ↓
Yield ↑	Duration ↓
Earlier cash flows	Duration ↓
Later cash flows	Duration ↑

SECTION VI — MODIFIED DURATION

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What Is Modified Duration?

Modified duration converts Macaulay duration into an approximate measure of percentage price sensitivity to yield changes.

$$D_{mod} = D_M \div (1 + y)$$

where y is the yield per period (annual compounding).

Why Modified Duration Matters

Modified duration = 6

> ***A 1 percentage-point increase in yield would cause the price to fall by about 6% — for a small yield change. And vice versa.***

Duration Price Approximation

$$\Delta P / P \approx -D_{mod} \times \Delta y$$

The negative sign represents the inverse relationship between yield and price.

Yield ↑
Price ↓

Yield ↓
Price ↑

Duration Example — Rates Rise

Modified duration
5

Yield change
+1 pp = +0.01

$$\Delta P / P \approx -5\,(0.01) = -5\%$$

The bond price falls approximately 5%.

Duration Example — Rates Fall

Modified duration
5

Yield change
−1 pp = −0.01

$$\Delta P / P \approx -5\,(-0.01) = +5\%$$

The bond price rises approximately 5%.

Compare Two Bonds

Bond A
Modified duration = 3 → about −3%

Bond B
Modified duration = 8 → about −8%

If yields increase by 1 percentage point, the approximate price changes differ sharply.

Bond B has far greater interest-rate sensitivity.

SECTION VII — PORTFOLIO DURATION

Duration Applies to Portfolios Too

For a portfolio of conventional bonds, portfolio duration can be approximated as the market-value-weighted average duration of the individual positions.

$$D_P = \Sigma w_i \times D_i$$

- w_i = portfolio weight of bond i
- D_i = duration of bond i

Portfolio Duration Example

Bond A
60% weight · Duration = 4

Bond B
40% weight · Duration = 8

$$D_P = (0.60)(4) + (0.40)(8) = 5.6$$

Interpreting Portfolio Duration

If portfolio modified duration is approximately 5.6 and yields rise broadly by 1 percentage point:

Portfolio value may decline about 5.6%

subject to the assumptions and limitations of duration.

SECTION VIII — LIMITATION OF DURATION

Duration Is an Approximation

Duration works best for relatively small yield changes. Why?

The truth
The price–yield relationship is curved

The estimate
Duration approximates it with a straight line

The tangent line drifts away from the curve as the yield change grows.

SECTION IX — CONVEXITY

Dr Abenet Yohannes, Ph.D.

What Is Convexity?

Convexity measures the curvature of the relationship between bond price and yield.

It improves price-change estimates when interest-rate changes are larger.

— Duration vs Convexity

Think of a curved road.

Duration
Pretends the road is locally straight

Convexity
Recognizes that the road bends

Combining duration and convexity produces a better approximation.

Duration + Convexity

$$\Delta P/P \approx -D_{mod}\,\Delta y + \tfrac{1}{2} \times \text{Convexity} \times (\Delta y)^2$$

Duration
First-order effect

Convexity
Curvature adjustment

Why Positive Convexity Can Be Attractive

For otherwise comparable option-free bonds:

- Price gains when yields fall can be larger than duration alone predicts
- Price losses when yields rise can be smaller than duration alone predicts

> ***Greater positive convexity can therefore be valuable.***

Duration vs Convexity

Duration	Convexity
First-order sensitivity	Curvature
Linear approximation	Nonlinear adjustment
Good for small changes	Improves larger-change estimates
Essential measure	Complementary measure

SECTION X — IMMUNIZATION

Protecting a future obligation

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What Is Immunization?

Immunization is a bond portfolio strategy designed to protect the ability to meet a future liability from adverse interest-rate movements.

Objective: ensure the portfolio can fund a specified future obligation despite moderate rate changes.

— Immunization

Suppose you need ETB 1 million exactly five years from now, and you invest in bonds today.

> ***Your concern: “What if interest rates change?”***

Immunization structures the portfolio so the future funding objective remains protected.

Two Opposing Effects

Rates rise
Bond prices ↓ but reinvestment rates ↑

Rates fall
Bond prices ↑ but reinvestment rates ↓

Immunization attempts to balance price risk against reinvestment risk.

Yield ↑
Price ↓

Yield ↓
Price ↑

Duration Matching

A simplified immunization approach aligns the duration of assets with the investment horizon or liability duration, along with appropriate present-value funding.

Price risk
Offset by reinvestment gains

Reinvestment risk
Offset by price gains

Immunization Example

Future liability: ETB 10 million in 7 years.

- Present value of assets supports the liability
- Portfolio duration is aligned with the liability horizon

> ***Goal: reduce sensitivity of the funding position to interest-rate changes.***

Immunization Is Not “Set and Forget”

As time passes:

- Bond durations change
- Yields change
- Portfolio values change
- The liability horizon shortens

Monitor → rebalance → monitor

SECTION XI — CASH-FLOW MATCHING

What Is Cash-Flow Matching?

Cash-flow matching constructs a bond portfolio whose cash flows correspond closely to scheduled liabilities.

Liability	Bond cash flow
Year 1	Year 1 cash flow
Year 2	Year 2 cash flow
Year 3	Year 3 cash flow

— Cash-Flow Matching

Suppose you owe:

- ETB 100,000 next year
- ETB 150,000 in Year 2
- ETB 200,000 in Year 3

You select bonds that generate approximately those amounts at those dates.

Money arrives when the bills arrive.

Advantages of Cash-Flow Matching

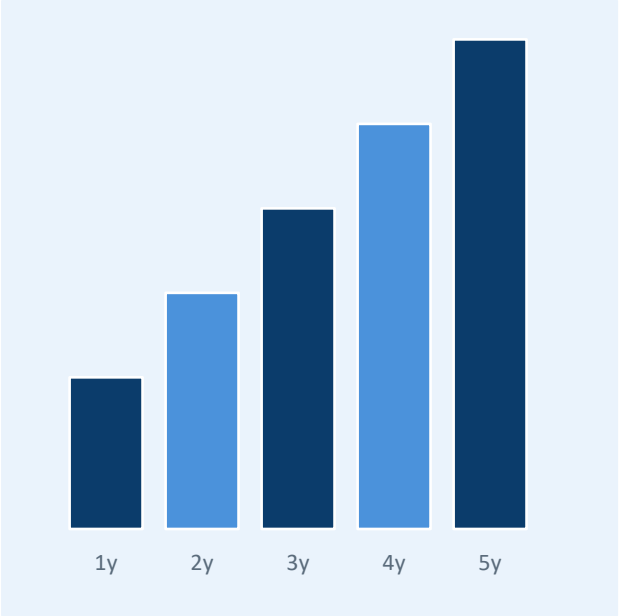
- Direct liability funding
- Reduced reinvestment dependence
- Clear planning
- Lower interest-rate uncertainty for matched obligations

> ***Limitation: it can be expensive or difficult to construct precisely.***

SECTION XII — BOND LADDERING

What Is a Bond Ladder?

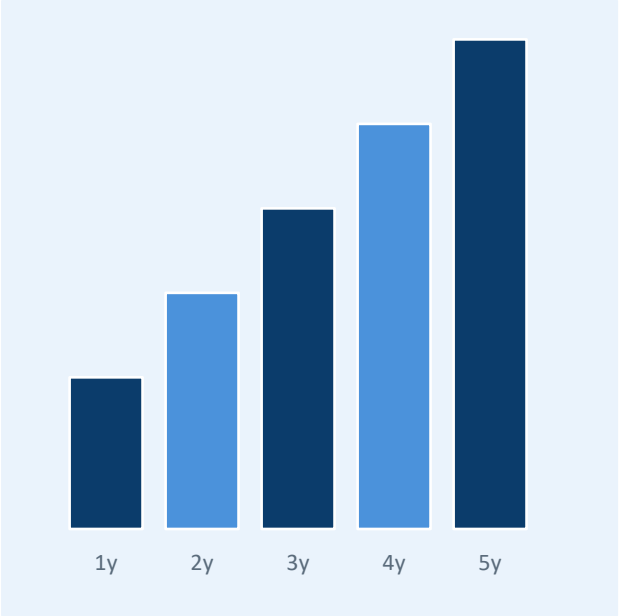
A bond ladder spreads maturities across different dates — for example 1-, 2-, 3-, 4- and 5-year bonds.



— Bond Ladder

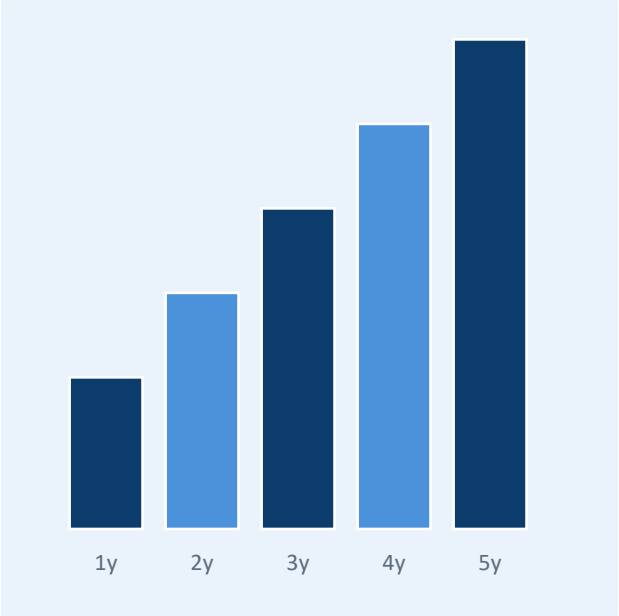
> ***Instead of putting all your money into one 10-year bond, divide it among bonds maturing at different times.***

As each bond matures, reinvest it at current rates. This reduces concentration in any single maturity date.



Potential Benefits of Laddering

- Regular maturities
- Liquidity
- Reinvestment opportunities
- Diversification across maturities
- Reduced timing risk



SECTION XIII — PASSIVE BOND STRATEGIES

What Is Passive Bond Management?

Passive management does not primarily attempt to forecast interest-rate movements or identify mispriced bonds.

- Buy and hold
- Indexing
- Immunization
- Cash-flow matching
- Laddering

Buy-and-Hold Strategy

Purchase bonds → collect coupons → hold to maturity

- Lower turnover
- Lower transaction costs
- Predictable contractual cash flows, subject to credit performance

Bond Indexing

A bond index strategy attempts to replicate or closely track a bond-market benchmark.

- Thousands of bonds
- Different maturities
- Continuous new issuance
- Bonds maturing out of the index
- Liquidity differences

> ***Therefore managers often use sampling rather than holding every bond.***

SECTION XIV — ACTIVE BOND MANAGEMENT

What Is Active Bond Management?

Active managers attempt to outperform a bond benchmark by taking views on:

- Interest rates
- The yield curve
- Credit spreads
- Sectors
- Individual securities

> ***Goal: generate excess return relative to the benchmark, after risk and costs.***

Interest-Rate Forecasting

Suppose a manager expects interest rates to fall. The manager may increase portfolio duration.

Expected rates ↓ → Duration ↑

Why? Long-duration bonds generally gain more when yields fall.

What If Rates Are Expected to Rise?

If the manager expects interest rates to rise, the manager may reduce duration.

Expected rates ↑ → Duration ↓

Why? Short-duration bonds generally experience smaller price declines.

Yield ↑
Price ↓

Yield ↓
Price ↑

The Forecasting Risk

Suppose the manager predicts rates will fall and increases duration — but rates actually rise sharply.

The portfolio may underperform significantly.

> ***Active management creates opportunity — and active risk.***

SECTION XV — YIELD-CURVE STRATEGIES

What Is a Yield-Curve Strategy?

Managers position portfolios based on expected changes in:

- The level of interest rates
- The slope of the yield curve
- The shape of the yield curve

Parallel Shift

A parallel shift occurs when yields across maturities move by approximately the same amount.

2-year
+1%

5-year
+1%

10-year
+1%

Steepening and Flattening

Steepening
Gap between long- and short-term yields increases

Flattening
The gap decreases

Portfolio managers adjust maturity exposures based on expectations about these changes.

SECTION XVI — MATURITY STRUCTURES

Bullet Portfolio

A bullet portfolio concentrates maturities around a particular date — for example, most bonds maturing around Year 10.

> ***Useful when a major liability occurs near a specific date.***

Barbell Portfolio

A barbell portfolio concentrates holdings at short maturities and long maturities, with fewer intermediate-maturity securities.

Short end
Liquidity, low price sensitivity

Long end
Yield, high price sensitivity

Ladder vs Bullet vs Barbell

Ladder
Maturities distributed over time

Bullet
Maturities concentrated around one horizon

Barbell
Maturities at short and long ends

Each structure produces a different mix of duration, reinvestment and liquidity exposure.

SECTION XVII — BOND SWAPS

What Is a Bond Swap?

A bond swap involves selling one bond and purchasing another to improve the portfolio's expected risk-return characteristics or positioning.

- Yield enhancement
- Credit view
- Interest-rate view
- Tax considerations
- Liquidity
- Portfolio rebalancing

Example — Substitution Swap

Suppose two bonds have very similar credit quality, coupon, maturity and features — but Bond A offers a meaningfully higher yield than Bond B.

Sell Bond B → Buy Bond A

if the yield difference appears attractive after considering risk and transaction costs.

SECTION XVIII — CREDIT STRATEGIES

Credit Spread Strategy

Credit spread = Corporate yield – Benchmark yield

If a manager expects a company's credit quality to improve, the credit spread may narrow and the bond price may rise.

> ***The manager may buy the bond before the expected improvement is fully reflected.***

Credit Strategy Risk

What if the analysis is wrong? Credit quality may deteriorate.

Spread widens → price falls → potential loss

> ***Higher yield should never be evaluated without considering why the yield is higher.***

SECTION XIX — CONTINGENT IMMUNIZATION

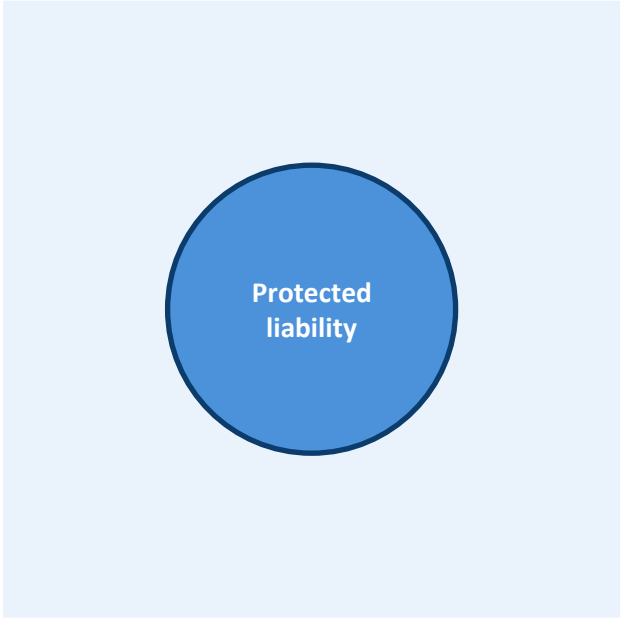
Dr Abenet Yohannes, Ph.D.

What Is Contingent Immunization?

Contingent immunization combines active management with immunization.

The manager actively manages while the portfolio has sufficient surplus. If the portfolio approaches a minimum acceptable value, the manager switches to immunization.

Active zone → safety threshold → immunized zone



SECTION XX — PRACTICAL APPLICATION

Practical Exercise — Pension Fund

Liability
ETB 50 million in 8 years

Market value
ETB 30 million

Portfolio duration
5 years

The fund manager expects interest rates to decline. Student tasks:

- Identify the fund's major interest-rate exposure and whether duration matches the 8-year horizon
- How might the manager increase duration, and what happens to long-duration bonds if rates fall?
- What happens if the forecast is wrong, and how could immunization or cash-flow matching help?
- Would a bullet, ladder or barbell structure be appropriate — and what credit risks apply?

Key Takeaways

- Bond portfolio management balances return, income, liquidity and risk; prices and yields move inversely
- Longer-maturity and lower-coupon bonds generally carry greater interest-rate sensitivity
- Macaulay duration measures present-value-weighted timing; modified duration estimates percentage price sensitivity
- Portfolio duration is the weighted average of holdings' durations; duration is a linear approximation
- Convexity captures curvature in the price–yield relationship and improves larger-change estimates
- Immunization protects future liability funding but requires monitoring and rebalancing
- Cash-flow matching aligns bond cash flows with liabilities; ladders diversify maturity dates
- Passive strategies emphasize predictable exposure and cost control; active managers take rate, curve and credit views
- Bullet, barbell and ladder structures give different maturity exposures; swaps alter yield, credit or rate exposure

Duration tells you how sensitive the portfolio is. Convexity improves the estimate. Immunization protects the objective.

Next Chapter — Macroeconomic and Industry Analysis

CHAPTER 12

Macro environment
Global economy, GDP, business cycles, inflation, interest rates

Policy & indicators
Monetary and fiscal policy, exchange rates, employment, leading indicators

Industry analysis
Life cycle, competition, sector rotation, economic sensitivity

From economic analysis to investment strategy: economy → industry → company → investment.

THANK YOU

Questions and Discussion

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