# Fixed-Income Portfolio Management (1, 2)

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|---|---|
| Topic Weight on Exam | 10–20% |
| SchweserNotes™ Reference | Book 3, Pages 200–303 |

Fixed Income Portfolio Management, Study Sessions 10 and 11, often become intertwined with the derivatives, currency, and asset-liability management material in earlier and later study sessions.

## Fixed-Income Portfolio Management—Part 1[1]

Cross-Reference to CFA Institute Assigned Reading #20

## Bond Indexing Strategies

Bond (and equity) portfolio management strategies form a continuum from an almost do-nothing approach (i.e., pure bond indexing) to a do-almost-anything approach (i.e., full blown active management) as demonstrated graphically in Figure 1.

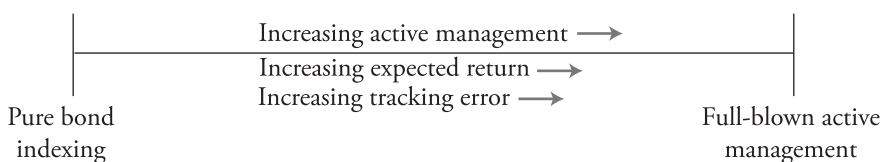### Figure 1: Increasing Degrees of Active Bond Portfolio Management



Increasing active management →
Increasing expected return →
Increasing tracking error →

Pure bond indexing

Full-blown active management

Figure 2 is a summary of the advantages and disadvantages of the bond portfolio strategies.

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1. Much of the terminology utilized throughout this topic review is industry convention as presented in Reading 20 of the 2017 Level III CFA curriculum.

**Figure 2: Advantages and Disadvantages of Bond Portfolio Management Strategies**

| Strategy | Advantages | Disadvantages |
|---|---|---|
| Pure bond indexing (PBI) | • Tracks the index (zero or very low tracking error)<br>• Same risk factor exposures as the index<br>• Low advisory and administrative fees | • Costly and difficult to implement<br>• Lower expected return than the index |
| Enhanced indexing by matching primary risk factors (sampling) | • Less costly to implement<br>• Increased expected return<br>• Maintains exposure to the index's primary risk factors | • Increased management fees<br>• Lowered ability to track the index (i.e., increased tracking error)<br>• Lower expected return than the index |
| Enhanced indexing by small risk factor mismatches | • Same duration as index<br>• Increased expected return<br>• Reduced manager restrictions | • Increased risk<br>• Increased tracking error<br>• Increased management fees |
| Active management by larger risk factor mismatches | • Slight difference in duration as compared to index<br>• Increased expected return<br>• Reduced manager restrictions | • Increased risk<br>• Increased tracking error<br>• Increased management fees |
| Full blown active management | • Increased expected return<br>• Few if any manager restrictions<br>• No limits on duration | • Increased risk<br>• Increased tracking error<br>• Increased management fees |

## SELECTING A BOND INDEX

Regardless of the strategy employed, the manager should be judged against a benchmark, and the benchmark should match the characteristics of the portfolio. Among others, there are four primary considerations when selecting a benchmark: (1) *market value risk,* (2) *income risk,* (3) *credit risk,* and (4) *liability framework risk.*

1.  *Market value risk* varies directly with maturity. The greater the risk aversion, the lower the acceptable market risk, and the shorter the benchmark maturity.

2.  *Income risk* varies indirectly with maturity. The more dependent the client is upon a reliable income stream, the longer the maturity of the benchmark.

3.  *Credit risk*. The credit risk of the benchmark should closely match the credit risk of the portfolio.

4.  *Liability framework risk* is applicable only to portfolios managed according to a liability structure and should always be minimized.

A valid benchmark should be investable in order to provide a valid alternative to hiring a manager. If the index is not investable, it is not a valid benchmark. The bond market provides several challenges to this requirement.

First, bond market securities are more heterogeneous and illiquid. Issues are unique with differences in maturity, seniority, and other features compared to stocks, which are generally issued as one type of stock. Compounding the problem, many issues do not trade regularly, pricing data is frequently based on appraisals, and trades are often not publicly reported.

Second, the resulting indexes from various vendors can appear similar but be quite different in characteristics.

Third, the risk characteristics can change quickly over time as new issues of bonds are added and those approaching maturity are deleted from the index.

Fourth is the "bums" problem as capitalized-weighted indexes may carry increased exposure to credit downgrades. Large issuance by an issuer leads to greater index weight, but large issuance is also related to excessive leverage and subsequent credit problems.

Lastly, it can be difficult for investors to find an index that matches their risk profile. For example, if long-term interest rates are historically low, bond issuers will finance debt longer term resulting in a higher duration in the index, whereas an investor may have a shorter duration time horizon.

The result is many active investors create custom benchmarks from a composite of indexes and sub-indexes to match the characteristics of a particular manager. Passive investors use sampling to replicate an index, and ALM portfolios use the liabilities as the benchmark.

## Aligning Risk Exposures

To avoid the costs associated with purchasing every bond in the index yet maintain the same risk exposures, the manager will usually hold a sample of the bonds in the index. One sampling technique often utilized is **stratified sampling** (a.k.a. *cell-matching*). Constructing a portfolio with risk exposures identical to the index,

however, does not require the composition of the portfolio (i.e., the bonds held) to be representative of the index. A portfolio can be constructed with exactly the same risk factor exposures as the index but with different securities utilizing a **multifactor model**. However, the manager must determine the risk profile of the index. Risk profiling the index requires measuring the index's exposure to factors including duration, key rate duration, cash flow distribution, sector and quality weights, and duration contribution, et cetera.

**Duration**. Effective duration (a.k.a. option-adjusted or adjusted duration), which is used to estimate the change in the value of a portfolio given a small parallel shift in the yield curve, is probably the most obvious risk factor to be measured. Due to the linear nature of duration, which makes it overestimate the increase or decrease in the value of the portfolio, the convexity effect is also considered.

**Key rate duration** measures the portfolio's sensitivity to twists in the yield curve.

The manager should also consider the **present value distribution of cash flows (PVD)** of the index used as the portfolio benchmark. PVD measures the proportion of the index's total duration attributable to cash flows falling within selected time periods.

The present value (i.e., the market value) of all cash flows from the index that fall in each period is divided by the present value of all cash flows (i.e., the benchmark market value) to determine the percentage of the total market value that is attributable to cash flows falling in each period.

Next, the manager multiplies the duration of a given period by the percentage of cash flows falling in that period to arrive at the duration contribution for that period. Dividing the duration contribution for each time period by the benchmark duration yields PVD. If the manager duplicates the benchmark PVD, the portfolio and the benchmark will have the same sensitivity to both shifts and twists in the yield curve.

**Sector and quality percent**. The manager should match the weights of both the sectors and qualities in the index.

**Sector duration contributions**. The manager should match the proportion of the index duration that is contributed by each sector in the index.

**Quality spread duration contribution**. The manager should match the proportion of the index duration that is contributed by each quality in the index, where quality refers to categories of bonds by rating.

**Sector/coupon/maturity cell weights**. Convexity is difficult to measure for callable bonds. To mimic the *callability* of bonds in the index (i.e., the sensitivity of their prices to interest rate changes) the manager is better off matching their sector, coupon, and maturity weights in the index.

**Issuer exposure**. The final risk factor considered is issuer exposure, which is a measure of the index's *event exposure*. In mimicking the index, the manager should use a sufficient number of securities in the portfolio so that the event risk attributable to any individual issuer is minimized.

## Classical Immunization

Interest rate risk has two components: price risk and reinvestment rate risk. *Price risk* refers to the decrease (increase) in bond prices as interest rates rise (fall). *Reinvestment rate risk* refers to the increase (decrease) in investment income as interest rates rise (fall). It is important to note that price risk and reinvestment rate risk cause opposite effects.

*Classic immunization* is the process of structuring a bond portfolio that balances any change in the value of the portfolio with the return from the reinvestment of the coupon and principal payments received throughout the investment period. The goal of classical immunization is to form a portfolio so that:

- If interest rates increase, the gain in reinvestment income ≥ loss in portfolio value.
- If interest rates decrease, the gain in portfolio value ≥ loss in reinvestment income.

To effectively immunize a single liability:

- *Select* a bond (or bond portfolio) with an effective duration equal to the duration of the liability.
- Set the present value of the bond (or bond portfolio) equal to the present value of the liability.

Without rebalancing, classical immunization only works for a 1-time instantaneous change in interest rates. Portfolios cease to be immunized for a single liability when:

- Interest rates fluctuate more than once.
- Time passes.

Rebalancing frequency is a cost-benefit trade-off. Transaction costs associated with rebalancing must be weighed against the possible extent to which the terminal value of the portfolio may fall short of its target liability.

**Immunization Against Non-Parallel Shifts**

Equating the duration of the portfolio with the duration of the liability does not guarantee immunization. *Immunization risk* can be thought of as a measure of the extent to which the terminal value of an immunized portfolio falls short of its target value as a result of arbitrary (nonparallel) changes in interest rates. Immunized portfolios with cash flows that are concentrated around the investment horizon have the lowest immunization risk.

## Adjusting Dollar Duration

Two primary steps:

1.  Calculate the new dollar duration of the portfolio.

2.  Calculate the **rebalancing ratio** and use it to determine the required percentage change in the value of each bond in the portfolio.

$$\text{rebalancing ratio} = \frac{\text{target DD}}{\text{new DD}}$$

%Δ = rebalancing ratio − 1

## Spread Duration

*Spread duration* measures the sensitivity of non-Treasury issues to a change in their spread above Treasuries of the same maturity. The spread is a function of perceived risk as well as market risk aversion.

## Extensions to Classical Immunization

When the goal is to immunize against a liability, we must consider the ability to combine indexing (immunization) strategies with active portfolio management strategies. Note that since active management exposes the portfolio to additional risks, immunization strategies are also *risk-minimizing strategies.*

The first modification or extension to classical immunization theory is the use of **multifunctional duration** (a.k.a. **key rate duration**). The manager focuses on certain key interest rate maturities.

The second extension is **multiple liability immunization**. The goal of multiple liability immunization is ensuring that the portfolio contains sufficient liquid assets to meet each of the liabilities as it comes due.

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The third extension is allowing for **increased risk**, or otherwise relaxing the minimum risk requirement of classical immunization. As long as the manager does not jeopardize meeting the liability structure, he can pursue increased risk strategies that could lead to excess portfolio value (i.e., a terminal portfolio value greater than the liability).

**Contingent immunization** is the combination of active management strategies and passive management techniques (immunization). As long as the rate of return on the portfolio exceeds a prespecified *safety net return*, the portfolio is managed actively. If the portfolio return declines to the safety net return, the immunization mode is triggered to "lock in" the safety net return. The safety net return is the minimum acceptable return as designated by the client.

## Immunization Risks

**Interest rate risk** is the primary concern when managing a fixed income portfolio, whether against a liability structure or a benchmark.

**Contingent claim risk** (a.k.a. call risk or prepayment risk). Callable bonds are typically called only after interest rates have fallen. This means that the manager not only loses the higher stream of coupons that were originally incorporated into the immunization strategy, she is faced with reinvesting the principal at a reduced rate of return.

**Cap risk**. If any of the bonds in the portfolio have floating rates, they may be subject to *cap risk*. As used here, cap risk refers to a cap on the floating rate adjustment to the coupon on a floating rate security. If the bonds are subject to caps when interest rates rise, they might not fully adjust and thus would affect the immunization capability of the portfolio.

## Immunizing Single Liabilities, Multiple Liabilities, and General Cash Flows

If a manager could invest in a zero-coupon Treasury with a maturity equal to the liability horizon, he has constructed an immunization strategy with no risk. Since this is rarely the case, however, the manager must take steps to *minimize risk*.

To reduce the risk associated with uncertain **reinvestment rates**, the manager should minimize the *distribution* of the maturities of the bonds in the portfolio around the (single) liability date. Concentrating the maturities of the bonds around the liability date is known as a **bullet strategy**. Think of a strategy employing two bonds. One bond matures one year before the liability date and the other matures one year after the liability date. When the first matures, the proceeds must be reinvested for only one year. At the date of the liability, the maturity of the other

is only one year off. Thus the reinvestment rate on the first will have a minimal impact on the terminal value of the portfolio and the value of the second is only minimally sensitive to interest rates.

Now consider a **barbell strategy** where the first bond matures several years before the liability date and the other several years after the liability date. The face value of the first must be reinvested when it matures, so the manager must be concerned with both the reinvestment rate and, since the new bond will have several years until maturity, all the other risk factors associated with such a bond. The second bond, since it matures several years after the liability date, is subject to significant interest rate risk. That is, the value of the bond at the liability date is determined by interest rates at that date.

As the maturities of the bonds used in the bullet strategy move away from the liability due date and the maturities of the barbell move toward the liability due date, the distinction between the two will begin to blur. Rather than base the strategy on subjective judgment, therefore, the manager can minimize $M^2$ (a.k.a. maturity variance).

Maturity variance is the variance of the differences in the maturities of the bonds used in the immunization strategy and the maturity date of the liability. For example, if all the bonds have the same maturity date as the liability, $M^2$ is zero. As the dispersion of the maturity dates increases, $M^2$ increases.

## Multiple Liabilities

Multiple liability immunization is possible if the following three conditions are satisfied (*assuming parallel rate shifts*):

1.  Assets and liabilities have the same present values.

2.  Assets and liabilities have the same aggregate durations.

3.  The range of the distribution of durations of individual assets in the portfolio exceeds the distribution of liabilities. This is a necessary condition in order to be able to use cash flows generated from our assets (which will include principal payments from maturing bonds) to sufficiently meet each of our cash outflow needs.

## Conditions for Cash Flow Matching

The following points describe the process:

- Select a bond with a maturity date equal to that of the last liability payment date.
- Buy enough in par value of this bond such that its principal and final coupon fully fund the last liability.
- Using a recursive procedure (i.e., working backwards), choose another bond that fully funds the second-to-last liability payment and continue until all liability payments have been addressed.

## General Cash Flows

*General cash flows* in this case refers to using cash as part of an immunization strategy even though the cash has not yet been received. For example, expecting a cash flow in six months, the portfolio manager does not put the entire amount required for immunization into the portfolio today. Instead he looks at the expected cash flows as a zero and incorporates its payoff and duration into the immunization strategy.

## Risk Minimization vs. Return Maximization

**Return maximization** is the concept behind *contingent immunization*. Consider the manager who has the ability to lock in an immunized rate of return equal to or greater than the required safety net return. As long as that manager feels he can generate even greater returns, he should pursue active management in hopes of generating excess value.

The following are the differences between cash flow matching and multi-liability immunization:

- Cash flow matching depends upon all the cash flows of the portfolio, so managers must use conservative reinvestment assumptions for all cash flows. This tends to increase the overall value of the required immunizing portfolio. An immunized portfolio is essentially fully invested at the duration of the remaining horizon, so only the average reinvestment ratio over the entire investment horizon must be considered.
- Owing to the exact matching problem, only asset flows from a cash-flow-matched portfolio that occur prior to the liability may be used to meet the obligation. An immunized portfolio is only required to have sufficient value on the date of each liability because funding is achieved through portfolio rebalancing.

**Combination matching**, also known as *horizon matching*, is a combination of multiple liability immunization and cash flow matching that can be used to address the asset cash flow/liability matching problem. This strategy creates a portfolio that is *duration* matched. During the first few years, the portfolio would also be cash flow matched in order to make sure that assets were properly dispersed to meet the near-term obligations.

Combination matching offers the following *advantages* over multiple liability immunization:

- Provides liquidity in the initial period.
- Reduces the risk associated with nonparallel shifts in the yield curve which usually take place in the early years.

The primary *disadvantage* of combination matching is that it tends to be more expensive than multiple liability immunization.

## RELATIVE-VALUE METHODOLOGIES FOR GLOBAL CREDIT BOND PORTFOLIO MANAGEMENT[2]
Cross-Reference to CFA Institute Assigned Reading #21

In relative value analysis, assets are compared along readily identifiable characteristics and value measures. In comparing firms, for example, we can use measures such as P/E ratios for ranking. With bonds, some of the characteristics used include sector, issue, and structure, which are used to rank the bonds across and within categories by expected performance. You are familiar with two of these methodologies:

- In the **top-down approach**, the manager uses economy-wide projections to first allocate funds to different countries or currencies. The analyst then determines what industries or sectors are expected to outperform and selects individual securities within those industries.
- The **bottom-up approach** starts at the "bottom." The analyst selects undervalued issues.

Any bond analysis should focus on total return. The analyst performs a detailed study of how past total returns for markets or individual securities were affected by macroeconomic events, such as interest rate changes and general economic performance. Any trends detected are used to estimate future total returns, based upon predictions for those same macro-trends.

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2.  The terminology presented in this topic review follows industry convention as presented in Reading 21 of the 2017 Level III CFA exam curriculum.

## Cyclical and Secular Changes

**Cyclical changes** are changes in the number of new bond issues. Increases in the number of new bond issues are sometimes associated with narrower spreads and relatively strong returns. Corporate bonds often perform best during periods of heavy supply.

**Secular changes**. In all but the high-yield market, intermediate-term bullets dominate the corporate bond market. Bullet maturities are not callable, putable, or sinkable. Callable issues still dominate the high-yield segment.

There are at least three implications associated with these product structures:

1. Securities with embedded options will trade at premium prices due to their scarcity value.

2. Credit managers seeking longer durations will pay a premium price for longer duration securities because of the tendency toward intermediate maturities.

3. Credit-based derivatives will be increasingly used to take advantage of return and/or diversification benefits across sectors, structures, and so forth.

## Liquidity

There is generally a positive relationship between liquidity and bond prices. As liquidity decreases, investors are willing to pay less (increasing yields), and as liquidity increases, investors are willing to pay more (decreasing yields).

The corporate debt market has shown variable liquidity over time, influenced to a great extent by macro shocks (i.e., a variety of economic conditions). And while some investors are willing to give up additional return by investing in issues that possess greater liquidity (e.g., larger-sized issues and government issues), other investors are willing to sacrifice liquidity for issues which offer a greater yield (e.g., smaller-sized issues and private placements). The move in debt markets has been toward increased liquidity (i.e., faster and cheaper trading) mainly due to trading innovations and competition among portfolio managers.

## Rationales for Secondary Bond Trades

The following are some of the reasons why managers actively trade in the secondary bond markets, rather than simply hold their portfolios. In all cases, the manager must determine whether trading will produce returns greater than the associated costs or not.

- Yield/spread pickup trades.
- Credit-upside trades.
- Credit-defense trades.
- New issue swaps.
- Sector-rotation trades.
- Yield curve-adjustment trades.
- Structure trades.
- Cash flow reinvestment trades.

## Assessing Relative Value Methodologies

**Rationales for not trading** include:

- Trading constraints.
- Story disagreement.
- Buy and hold.
- Seasonality.

## Spread Analysis

**Mean-reversion analysis**. The presumption with mean reversion is that spreads between sectors tend to revert toward their historical means.

- If the current spread is significantly greater than the historic mean, buy the sector or issue.
- If the current spread is significantly less than the historic mean, sell the sector or issue.
- Statistical analysis, using standard deviations and t-scores (for determining significance), can be used to determine if the current spread is significantly different from the mean.

**Quality-spread analysis**. Quality-spread analysis is based on the spread differential between low and high quality credits.

**Percentage yield spread analysis**. Percentage yield spread analysis *divides* the yields on corporate bonds by the yields on treasuries with the same duration. If the ratio is higher than justified by the historical ratio, the spread is expected to fall, making corporate bond prices rise.

## Bond structures

### Bullet Structures

Short-term bullets have maturities of one to five years and are used on the short end of a barbell strategy. As opposed to using short-term Treasuries, corporate securities are used at the front end of the yield curve with long-term Treasuries at the long end of the yield curve.

Medium-term bullets (maturities of 5 to 12 years) are the most popular sector in the United States and Europe. When the yield curve is positively sloped, 20-year structures are often attractive, because they offer higher yields than 10- or 15-year structures but lower duration than 30-year securities.

Long-term bullets (30-year maturities) are the most commonly used long-term security in the global corporate bond market. They offer managers and investors additional positive convexity at the cost of increased effective duration.

### Early Retirement Provisions

Due to the *negative convexity* caused by the embedded option, *callable* bonds:

- **Underperform** non-callables when interest rates fall (relative to the coupon rate) due to their negative convexity.
- **Outperform** non-callables in bear bond markets with rising rates as the probability of call falls. (When the current rate is lower than the coupon rate, their negative convexity makes callables respond less to increasing rates.)
- When yields are very high, relative to coupon rates, the callable bond will behave much the same as the non-callable (i.e., the call option has little or no value).

**Sinking funds**. Sinking fund structures priced at a discount to par have historically retained upside price potential during interest rate declines as long as the bonds remain priced at a discount to par (and the firm can call the bonds at par). Furthermore, given that the issuer is usually required to repurchase part of the issue each year, the price of sinking fund structures does not fall as much relative to callable and bullet structures when interest rates rise.

## CREDIT ANALYSIS

Credit analysis involves examining financial statements, bond documents, and trends in credit ratings. It provides an analytic framework in assessing key information in sector selection:

- Capacity to pay is the key factor in corporate credit analysis.
- The quality of the collateral and the servicer are important in the analysis of asset-backed securities.
- The ability to assess and collect taxes is the key consideration for municipal bonds.
- Sovereign credit analysis requires an assessment of the country's ability to pay (economic risk) and willingness to pay (political risk).

## FIXED-INCOME PORTFOLIO MANAGEMENT—PART II
Cross-Reference to CFA Institute Assigned Reading #22

## Leveraged Portfolio Return

$R_P = R_i + [(B / E) \times (R_i - c)]$

where:
$R_P$ = return on portfolio
$R_i$ = return on invested assets
B  = amount on leverage
E  = amount on equity invested
c   = cost of borrowed funds

The formula says to add the return on the investment (the first component) to the net levered return (the second component in brackets).

## Leveraged Duration

$$D_P = \frac{D_i I - D_B B}{E}$$

where:
$D_P$ = duration of portfolio
$D_i$ = duration of invested assets
$D_B$ = duration of borrowings
I   = amount of invested funds
B  = amount of leverage
E  = amount of equity invested

## Repurchase Agreements

In a *repurchase agreement* or repo, the borrower (seller of the security) agrees to repurchase it from the buyer on an agreed upon date at an agreed upon price (repurchase price).

Although it is legally a sale and subsequent purchase of securities, a repurchase agreement is essentially a collateralized loan, where the difference between the sale and repurchase prices is the interest on the loan. The rate of interest on the repo is referred to as the *repo rate*.

### The Repo Rate

- The repo rate increases as the **credit risk** of the borrower increases (when delivery is not required).
- As the **quality** of the collateral increases, the repo rate declines.
- As the **term** of the repo increases, the repo rate increases.
- **Delivery**. If collateral is physically delivered, then the repo rate will be lower. If the repo is held by the borrower's bank, the rate will be higher. If no delivery takes place, the rate will be even higher.
- **Collateral**. If the availability of the collateral is limited, the repo rate will be lower.
- The higher the **federal funds rate**, the higher the repo rate.
- As the demand for funds at financial institutions changes due to **seasonal factors**, so will the repo rate.

## Bond Risk Measures

### Standard Deviation

The problems with standard deviation and variance are as follows:

- Bond returns are often not normally distributed around the mean.
- The number of inputs (e.g., variances and covariances) increases significantly with larger portfolios.
- Historically calculated risk measures may not represent the risk measures that will be observed in the future.

### Semivariance

Drawbacks of semivariance include the following:

- It is difficult to compute for a large bond portfolio.
- If investment returns are symmetric, the semivariance yields the same rankings as the variance and the variance is better understood.

- If investment returns are not symmetric, it can be quite difficult to forecast downside risk and the semivariance may not be a good indicator of future risk.
- Because the semivariance is estimated with only half the distribution, it is estimated with less accuracy.

### Shortfall Risk

Shortfall risk measures the *probability* that the actual return will be less than the target return.

The primary criticism of the shortfall risk measure is:

- Shortfall risk does not consider the impact of outliers so the magnitude (dollar amount) of the shortfall below the target return is ignored.

### Value at Risk

The primary criticism of VAR is:

- As in the shortfall risk measure, VAR does not provide the magnitude of losses that exceed that specified by VAR.

### ADVANTAGES OF INTEREST RATE FUTURES

Compared to cash market instruments, futures:

1. Are more liquid.

2. Are less expensive.

3. Make short positions more readily obtainable, because the contracts can be more easily shorted than an actual bond.

### HEDGING WITH INTEREST RATE FUTURES

To **increase** duration → **buy** futures contracts.

To **decrease** duration → **sell** futures contracts.

The number of contracts can be calculated as:

$$\text{number of contracts} = \frac{(D_T - D_P)P_P}{D_{CTD}P_{CTD}}(\text{CTD conversion factor})(\text{yield beta})$$

A less commonly used formula works from dollar durations (DD) and will reach the same result if all data is correctly presented. On the exam use the formula for which the necessary data is given.

$$\text{number of contracts} = \frac{DD_T - DD_P}{DD_f}$$

where DD is:

DD = ($\Delta$value) = –(effective duration)(decimal change in interest rates)(value)

A change in interest rates of 100bp (1.00%) is assumed unless otherwise specified.

## Hedging Issues

### *Basis Risk and Cross Hedging*

**Basis** is the difference between the spot and forward price of an asset at any one point in time. **Basis risk** is used in its most technical sense to refer to an unexpected change in the basis. If a hedge is held to expiration of a contract, there will be no basis risk because convergence dictates the spot and forward price will be equal and the basis will be known; it will be zero. This means that hedges held to expiration will be less risky than other hedges.

However, basis risk is also used in a more general sense to mean any risk in the hedge. Under this definition, even hedges held to expiration can have basis risk. In a **cross hedge**, the item being hedged and the item underlying the hedging vehicle are not the same. They are highly, but not perfectly, correlated. If their relative price movement is not as modeled, then the cross hedge will not perform as expected. Fixed income hedging using Treasury contracts will always have cross hedge risk because both the relationship between the contract and CTD bond can change and the relationship of the CTD and the item being hedged can change.

### Evaluating Hedging Effectiveness

There are three basic sources of hedging error.

There can be an error in the:

1. Forecast of the basis at the time the hedge is lifted.

2. Estimated durations.

3. Estimated yield beta.

## Managing Default Risk, Credit Spread Risk, and Downgrade Risk With Derivatives

### Types of Credit Risk

There are three principal credit-related risks that can be addressed with credit derivative instruments:

1. **Default risk** is the risk that the issuer will not meet the obligations of the issue (i.e., pay interest and/or principal when due). This risk is unique in the sense that it results from a potential action—failure to pay—of the debt issuer.

2. **Credit spread risk** is the risk of an increase in the yield spread on an asset.

3. **Downgrade risk** is the possibility that the credit rating of an asset/issuer is downgraded by a major credit-rating organization, such as Moody's.

### Types of Credit Derivative Instruments

**Credit options**. Credit options provide protection from adverse price movements related to credit events or changes in the underlying reference asset's spread over a risk-free rate. When the payoff is based on the underlying asset's price, the option is known as a binary credit option. When the payoff is based on the underlying asset's yield spread, the option is known as a credit spread option.

**Binary credit options**. A binary credit put option on price will provide protection if a specific credit event occurs, and if the value of the underlying asset is less than the option strike price. The option value (OV) or payoff is:

$$OV = \max\,[(\text{strike} - \text{value}),\, 0]$$

**Credit spread options**. A credit spread call option on price will provide protection if the reference asset's spread over the relevant risk-free benchmark increases beyond the strike spread. The increase in the spread beyond the strike spread (i.e., the option being in the money) constitutes an identifiable credit event, in and of itself. The option value (OV) or payoff is:

$$OV = \max\,[(\text{actual spread} - \text{strike spread}) \times \text{notional} \times \text{risk factor},\, 0]$$

**Credit spread forwards.** Credit spread forwards are forward contracts wherein the payment at settlement is a function of the credit spread over the benchmark at the

time the contract matures. The value (FV) or payoff to the buyer of a credit spread forward is:

$$FV = (\text{spread at maturity} - \text{contract spread}) \times \text{notional} \times \text{risk factor}$$

**Credit swaps**. Credit swaps describe a category of products in the swap family, all of which provide some form of credit risk transfer. Our focus here will be on **credit default swaps** which can be viewed as protection, or insurance, against default on an underlying credit instrument (called the reference asset or reference entity when referring to the issuer).

To obtain the requisite insurance, the protection buyer agrees to pay the protection seller a periodic fee in exchange for a commitment to stand behind an underlying bond or loan should its issuer experience a credit event, such as default. A credit default swap agreement will contain a list of credit events that apply to the agreement.

The terms of a credit swap are custom-designed to meet the needs of the counterparties. They can be cash settled or there can be physical delivery, which generally means the buyer of the swap delivers the reference asset to the counterparty for a cash payment.

## International Bond Excess Returns

Six of the potential sources of excess return on international bonds are: (1) market selection; (2) currency selection; (3) duration management; (4) sector selection; (5) credit analysis; and (6) markets outside the benchmark.

**Market selection** involves selecting appropriate national bond markets.

**Currency selection**. The manager must determine the amount of active currency management versus the amount of currency hedging he will employ. Due to the complexities and required expertise, currency management is often treated as a separately-managed function.

**Duration management**. Once the manager has determined what sectors (i.e., countries) will be held, she must determine the optimal maturities. Limited maturity offerings in some markets can be overcome by employing fixed income derivatives.

**Sector selection**. This is directly analogous to domestic bond portfolio management. Due to increasing ranges of maturities, ratings, and bond types (e.g., corporate, government), the international bond portfolio manager is now able to add value through credit analysis of entire sectors.

**Credit analysis** refers to recognizing value-added opportunities through credit analysis of individual securities.

**Markets outside the benchmark**. Large foreign bond indices are usually composed of sovereign (government) issues. With the increasing availability of corporate issues, the manager may try to add value through enhanced indexing by adding corporates to an indexed foreign bond portfolio.

## INTERNATIONAL BOND DURATIONS

To estimate the sensitivity of the prices of foreign bonds to changes in the domestic interest rate, the manager must measure the *correlations* between changes in their yields and changes in the domestic interest rate.

Assuming there is a relationship (i.e., correlation) between yields on the domestic and foreign bonds, the manager can regress the yield on the foreign bond against the yield on a domestic bond of similar risk and maturity:

$$\Delta yield_{foreign} = \beta_{yield} \left(\Delta yield_{domestic}\right) + e$$

In the regression, $\beta$ is the *country beta* or *yield beta*, which measures the sensitivity of the yield on the foreign bond to changes in the yield on the domestic bond. Multiplying the country beta times the change in the domestic rate gives the manager the estimated change in the foreign yield.

### Duration Contribution of a Foreign Bond

The duration of a foreign bond must also be adjusted when we calculate its *contribution* to the portfolio duration. The contribution of a domestic bond to the duration of a domestic portfolio is the bond's weight in the portfolio multiplied by its duration. The duration contribution of a foreign bond to a domestic portfolio is its weight in the portfolio multiplied by its (foreign) duration and its country beta.

## THE HEDGING DECISION

### Interest Rate Parity

The IRP formula summarizes this arbitrage-free relationship:

$$F = S_0 \left( \frac{1 + c_d}{1 + c_f} \right)$$

We can *approximate* the forward premium or discount (i.e., the *currency differential*) as the difference in short-term rates:

$$f_{d,f} = \frac{(F - S_0)}{S_0} \approx c_d - c_f$$

### COVERED INTEREST ARBITRAGE

Covered interest arbitrage forces interest rates toward *parity*, because risk-free rates must be the same across borders when forward exchange rates exist. If the nominal domestic interest rate is low relative to the nominal foreign interest rate, the foreign currency *must* trade at a forward discount (this relationship is forced by arbitrage). Alternatively, if the nominal home interest rate is high relative to the nominal foreign interest rate, the foreign currency must trade at a forward premium.

We can check for an arbitrage opportunity by using the covered interest differential. The covered interest differential says that the domestic interest rate should be the same as the *hedged* foreign interest rate. More specifically, the difference between the domestic interest rate and the hedged foreign rate should be zero.

The covered interest differential can be viewed by rewriting IRP in the following way:

$$(1 + c_d) = (1 + c_f) \left( \frac{F}{S_0} \right)$$

The left-hand side of the equation is the domestic interest rate, while the right-hand side is the hedged foreign rate (the foreign rate expressed in domestic terms). Arbitrage will prevent this relationship from getting out of balance. To preclude arbitrage, the left-hand side minus the right-hand side should equal zero. Hence, the covered interest differential can be written as:

$$(1 + c_d) - (1 + c_f) \left( \frac{F}{S_0} \right) = \text{covered interest differential}$$

## Hedging Techniques

The **forward hedge**. The forward hedge is used to eliminate (most of) the currency risk. Utilizing a forward hedge assumes forward contracts are available and actively traded on the foreign currency in terms of the domestic currency. If so, the manager enters a forward contract to sell the foreign currency at the current forward rate.

The **proxy hedge**. In a proxy hedge the manager enters a forward contract between the *domestic currency and a second foreign currency* that is correlated with the first foreign currency (i.e., the currency in which the bond is denominated). Gains or losses on the forward contract are expected to at least partially offset losses or gains in the domestic return on the bond. Proxy hedges are utilized when forward contracts on the first foreign currency are not actively traded or hedging the first foreign currency is relatively expensive.

The **cross hedge**. Notice that in currency hedging the proxy hedge is what we would usually refer to as a cross hedge in other financial transactions. In other words, the manager can't construct a hedge in the long asset, so he hedges using another, correlated asset. In a currency cross hedge, the manager enters into a contract to deliver the original foreign currency (i.e., the currency of the bond) for a third currency. Again it is hoped that gains or losses on the forward contract will at least partially offset losses or gains in the domestic return on the bond. In other words, the manager takes steps to eliminate the currency risk of the bond by replacing it with the risk of another currency. The currency cross hedge, therefore, is a means of changing the risk exposure rather than eliminating it.

## The Hedging Decision

Using only the following data on two foreign bonds with the same risk characteristics (e.g., maturity, credit risk) **determine** which bond should be purchased, if the currency risk of either can be fully hedged with a forward contract.

| Country | Nominal Return | Risk-Free Rate |
|---------|----------------|----------------|
| i | 4.75% | 3.25% |
| j | 5.25% | 3.80% |

**Answer:**

Since their maturities and other risk characteristics are similar and an investment in either can be hedged using a forward contract, we can determine the better bond to purchase by calculating their excess returns:

Bond i: 4.75% – 3.25% = 1.50%

Bond j: 5.25% – 3.80% = 1.45%

Bond i offers the higher excess return, so given the ability to fully hedge the manager should select Bond i.

## To Hedge or Not to Hedge

A U.S. manager is considering a foreign bond. The U.S. risk-free rate (i.e., the domestic rate) is 4% and the risk-free rate in the foreign country (i.e., the local rate) is 4.8%. The manager expects the dollar to appreciate only 0.4% over the expected holding period. Based on this information and assuming the ability to hedge with forward contracts, **determine** whether the manager should hedge the position or leave it unhedged.

**Answer:**

We start by calculating the forward differential expected by the market:

$$f \approx i_d - i_f = 4.0\% - 4.8\% = -0.8\%$$

The current nominal risk-free interest rates imply a forward differential of –0.8%; the market expects the foreign currency to depreciate 0.8% relative to the dollar. The manager on the other hand expects the dollar to appreciate only 0.4%. If the manager's expectations are correct, the *forward dollar is too expensive*, or alternatively, the forward price of the foreign currency is too cheap. The manager is better off not hedging the currency risk, as the foreign currency will not fall in value as much as predicted by the market.

## BREAKEVEN SPREAD ANALYSIS

Breakeven analysis is an active management bond swap tool. It identifies the spread change between two bonds at which the manager *can be sure* the bond selected would outperform.

*Step 1:* Identify the two bonds and the difference in expected return over a specified time period.

*Step 2:* Calculate the breakeven spread change such that relative price performance will just offset the projected return difference in Step 1.

Consider bonds i and j yielding 4.75% and 5.25%. Their durations are 4 and 5. The holding period is 6 months for a periodic yield, and the projected return difference is calculated as follows: (5.25 – 4.75)/2 = 25bp. There are three scenarios.

A.  Buy j to pick up expected return. The risk is the spread widens. Bond j can underperform in relative price by no more than 25bp. Breakeven spread change (BES) is –25bp = –5(BES). BES is a widening of no more than 5bp. When the risk is spread widening (bought the higher yield bond), use the higher duration to be sure BES will not lead to underperformance.

B.  Buy i and give up yield. This is a less common trade. The spread must widen for a relative price gain by bond i to reach breakeven. Bond i must outperform in relative price by at least 25bp. BES is 25bp = –4(BES). BES is widening of at least 6.25bp. (Technically there is a minus sign, which means the yield on i must decline versus j.) When a spread widening is required (bought the lower yield bond), use the lower duration to be sure BES will lead to outperformance.

C.  The analyst (question) directs which bond's yield will change. If so, use that bond's duration to calculate BES.

## EMERGING MARKET DEBT

In actively managing a fixed income portfolio, managers often utilize a **core-plus** approach. In a core-plus approach, the manager holds a *core* of investment grade debt and then invests in bonds perceived to add the potential for generating added return. Emerging market debt (EMD) is frequently utilized to add value in a core-plus strategy.

*Advantages* of investing in EMD include:

• Increasing quality in emerging market sovereign bonds.

- Increased resiliency; the ability to recover from value-siphoning events.
- Lack of diversification in the major EMD index, the Emerging Markets Bond Index Plus (EMBI+). The index is concentrated in Latin American debt (e.g., Brazil, Mexico). The bond investor can diversify the fixed income portfolio, so an undiversified index offers return-enhancing potential.

*Risks* associated with EMD include:

- Unlike emerging market governments, emerging market corporations do not have the tools available to help offset negative events.
- EMD returns can be highly volatile with negatively skewed distributions.
- A lack of transparency and regulations gives emerging market sovereign debt higher credit risk than sovereign debt in developed markets.
- Under-developed legal systems that do not protect against actions taken by governments.
- A lack of standardized covenants.
- Political risk (a.k.a. geopolitical risk).

## Selecting a Fixed Income Manager

Criteria that should be utilized in determining the *optimal mix* of active managers include *style analysis, selection bets, investment processes*, and *alpha correlations*.

**Style analysis**. The majority of active returns can be explained by the manager's selected style. The primary concerns associated with researching the managers' styles include not only the styles employed but any additional risk exposures due to style.

**Selection bets**. Selection bets include credit spread analysis (i.e., which sectors or securities will experience spread changes) and the identification of over- and under-valued securities. By decomposing the manager's excess returns, the sponsor can determine the manager's ability to generate superior returns from selection bets.

**Investment processes.** This step includes investigating the total investment processes of the managers. What type of research is performed? How is alpha attained? Who makes decisions and how are they made (e.g., committee, individual).

**Alpha correlations.** If the alphas of the various managers are highly correlated, not only will there be significant volatility in the overall alpha, but the alphas will tend to be all positive or negative at the same time.

The process for determining the best mix of fixed income active managers is much the same as that for selecting the best mix of equity portfolio managers. The one consideration that distinguishes the two is the need for a low-fee strategy. That is, fees are an important consideration in selecting any active manager, but the ratio of fees to alpha is usually higher for fixed income managers.