SchweserNotes™

Fixed Income and Equity

Book 3: Fixed Income and Equity

SchweserNotes™ 2024

Level III CFA®

SCHWESERNOTES™ 2024 LEVEL III CFA® BOOK 3: FIXED INCOME AND EQUITY

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READING 9

OVERVIEW OF FIXED-INCOME PORTFOLIO MANAGEMENT

EXAM FOCUS

This reading provides a good overview of issues covered in more detail in subsequent readings, so don't obsess about exact nuances of terminology. Take in what is said and move on to the rest of fixed income to see what we are going to do with these ideas and concepts. Do take the time to understand the model for projecting or decomposing bond return.

We make reference to historical results such as return, standard deviation, and correlation in this reading. They reflect results reported in the CFA reading. The numbers are to suggest typical relationships. They are not to be memorized and do not dictate what can happen in any specific period.

MODULE 9.1: ROLE OF FIXED INCOME

Video covering this content is available online.

LOS 9.a: Discuss roles of fixed-income securities in portfolios and how fixed-income mandates may be classified.

The fixed-income market is highly varied. It includes publicly traded securities such as bond and money market securities as well as nonpublic instruments such as loans and private placement securities. It varies by maturity and credit quality segments. There are structure differences such as straight bonds without embedded options, instruments with embedded prepayment options, variable coupon structures, and inflation adjustment features.

As an asset class used in a portfolio, fixed income may provide:

1. *Diversification*. In general, fixed income has low correlation to equity markets. Adding an asset class to an existing portfolio with a correlation of less than +1 improves its risk-adjusted return through diversification benefits. The lower the correlation, the greater the diversification benefit. Specific correlation numbers vary by time period and type of instrument used. For 2000 to 2019, the correlations of various fixed-income indexes to the S&P 500 equity index ranged from –0.30 for 10-year U.S. Treasury bonds to +0.63 for U.S. high-yield (credit-risky) bonds.

   Diversification can be achieved internally within the fixed-income asset class, primarily due to changes in credit spreads causing divergence in the performance

of investment-grade securities versus credit-risky high-yield (below investment-grade) securities.

These correlations are not always stable over time. A particular problem is flight to quality. During periods of market stress, all lower-quality and riskier assets, including high-yield bonds and equities, tend to decline together (correlation approaching +1) as investors sell these assets and buy high-quality developed-market government bonds for safety. Thus, correlation of these government bonds to riskier assets declines during periods of stress and may be negative.

The volatility of bond market returns can also vary over time, increasing significantly for high-yield bonds in times of market crisis.

2. *Regular cash flow.* Most fixed income provides regular, predictable cash flow that investors can use to meet expected future obligations. This is convenient for an individual needing regular living expenses or specific periodic expenditures such as college tuition payments. Institutions such as insurance companies that must make periodic payments to policyholders could structure and dedicate a portfolio of bond assets to meet these payouts. Investors could also build a buy-and-hold laddered portfolio of bonds to provide regular cash flow. Buy and hold means no sales or trading are planned, and laddered means a somewhat equal amount of par comes due periodically. Implicit in this discussion is that there is no significant credit risk and that all payments will be made on the bonds.
3. *Inflation hedge.* While not the first thing most investors would think of, some types of bonds do provide forms of inflation protection. Standard fixed-coupon (nominal rate) bonds do not. For simplicity, assume the bonds are purchased at par so that initial yield is the coupon rate. The purchase yield and coupon reflect nominal compensation for an expected future rate of inflation and a real return above that rate of inflation. If inflation increases, the coupon cash flow is fixed and the investor suffers on an inflation-adjusted basis. Looked at another way, the yield a new investor would want increases and the price of the bond must decline.
   – Inflation-linked (also called real rate or real return) bonds provide direct protection for the effect of inflation. Like regular bonds, the coupon payment amount is the coupon rate × par. But unlike regular bonds, the par adjusts for inflation. If 1 million par is purchased and inflation is 5%, the par increases by 5% to 1.05 million. (For later comparison with floating-coupon bonds, assume the previous inflation rate was 3%, though this does not directly affect the calculations for the inflation-linked bond.) That leads the coupon payment amount to increase by 5% as well. For example, if the real rate were 0.5%, the first (annualized) coupon payment is 5,250 (1,050,000 × 0.005). This adjustment continues every period to compensate for cumulative inflation over the life of the bond. At expiration, inflation-adjusted par is paid to the investor. Thus, both coupon payments and par are inflation protected.
   – Floating-coupon (floating-rate) securities also provide inflation protection. The coupon rate is set by a formula such as the market reference rate (MRR) + 100 basis points. If inflation and MRR are initially 3.0% and 3.5%, the first (annual) coupon payment on 1 million par would be 45,000 [1,000,000 (0.035 + 0.01)]. If inflation then increases by 2% to 5.0%, it is likely MRR will also increase by 2% to 5.5% and the next coupon payment will increase to 65,000 [1,000,000 (0.055

+ 0.01)]. No adjustment is made to the par amount. Thus, it is said the coupons are inflation protected but not the principal.

PROFESSOR'S NOTE

It is easy to misunderstand this material. In theory, both inflation-linked and floating-coupon securities provide full inflation protection but do so in different ways. Imagine fixed-coupon nominal rate (NR), inflation-linked, and floating-coupon bonds from the same issuer with the same maturity. In a fully efficient market, all three would be priced to reflect the same consensus expectations for inflation and have the same expected return. (Because they respond to inflation risk differently, there could be small differences.) If the actual rates of inflation turn out to higher (lower) than initial consensus expectations, the actual returns for the inflation linked and floating coupon would be superior (inferior) to the NR bond. Between the inflation linked and floating coupon, one or the other may end up being best depending on the actual path of future inflation. Notice in the earlier example with inflation increasing from 3% to 5% the par and coupon payment amount for the inflation-linked bond increased by 5% while the par of the floating coupon was unchanged, but the coupon payment amount went from 45,000 to 65,000, an increase of 44.4%.

The bottom line is to accept the conclusions as presented in the reading; they are correct. You can come back and develop spreadsheet models to test various scenarios after you have the charter. If you like bonds, it is fun to do so.

Fixed-Income Mandates

Fixed-income investment mandates can be classified into two major types: liability-based mandates and total return mandates.

Liability-based mandates are portfolio assets that are managed solely to meet expected future liability payouts. All asset cash flows are reinvested until paid out to meet the liabilities. This is often referred to as immunization. There are several forms and variations of **immunization**.

- **Cash-flow matching** is the simplest form of immunization. The assets are selected so that cash flows occur when and in the size needed to meet the liability payouts.
- **Duration matching** matches the duration of the assets and liabilities so the two will fluctuate in a similar way as interest rates change, such that their ending values will remain matched.
- **Contingent immunization (CI)** is a hybrid of active management and immunization. The portfolio is initially funded with more money than required to meet the future liability payouts. The present value of the assets (PVA) exceeds the present value of the liabilities (PVL). The difference is the surplus. As long as the surplus is positive, the portfolio can be managed in any way the manager believes will add value. If CI succeeds, the surplus will grow and the ultimate cost of CI will be less than that of initially immunizing. If the active management is unsuccessful and the surplus declines to zero, the portfolio must be immediately immunized

and the ultimate cost of CI will be more than that of initial immunization but by a known amount.

- **Derivatives overlays**, involving the use of futures or swaps contracts, can be used to implement duration matching or contingent immunization strategies.

Total return mandates do not seek to fund future liabilities but may target an absolute rate of return or, more commonly, seek to equal or outperform (relative return versus) a benchmark. The key metrics to evaluate such portfolios are **active return** (portfolio return less return of the relevant benchmark, also called value added or alpha) and volatility of that active return (standard deviation of active return, also called **active risk**, **tracking error**, or **tracking risk**). Total return mandates include the following:

- **Pure indexing**, which attempts to replicate the performance of a bond index. It targets zero active return and risk. Unlike the equity market, the large number of individual bonds in most indexes and their potential lack of liquidity makes literal duplication of the index (holding every issue in the same weight as in the index) impractical. Most pure bond indexing instead seeks to exactly match all the risk factors of the index (such as duration, credit or quality, sectors, and prepayment risks) while still allowing the manager some leeway on the individual bonds selected. The turnover (trading) in the portfolio should be low and similar to the turnover in the index.
- **Enhanced indexing** allows some additional flexibility in constructing the portfolio and seeks to add some modest active return. Typically, duration (interest rate risk) is still matched to the index, but some risk mismatches such as modest over- or underweighting of sectors and quality are allowed. Slightly higher portfolio turnover is likely.
- **Active management** allows much larger deviations from the risk factors of the index and seeks greater active return. Duration can also be mismatched and portfolio turnover can be much higher.

Fixed-Income Portfolio Measures

LOS 9.b: Describe fixed-income portfolio measures of risk and return as well as correlation characteristics.

PROFESSOR'S NOTE

This section reviews some fundamental definitions of fixed-income risk and return measures, almost all of which have been met at previous levels of the CFA program. Remember that the Level III exam will likely be less focused on the calculation of these measures than previous levels were and more focused on the interpretation and use of these measures in a portfolio management situation. Understanding what the measures are telling you is the key focus here.

Key bond risk and return measures are displayed here:

Name	Definition	Interpretation
Macaulay duration	Weighted average *time* to receive cash flows, where weights are the present value of the cash flows	A higher Macaulay duration means investors are waiting longer to receive cash flows and hence face higher price volatility when yields change.
Modified duration	Macaulay duration divided by one plus the periodic yield of the bond	This gives the approximate expected percentage change in bond price for a 1% change in yield. For example, a bond with a modified duration of 7 is expected to fall by approximately 7% when yields rise by 1%.
Effective duration	Sensitivity of a bond's price to a parallel shift change in a benchmark yield curve, based on directly modeling changes in prices due to changes in a benchmark curve	This gives the approximate expected percentage change in bond price for a 1% change in benchmark curve. Effective duration is used for complex bonds where cash flows are not certain, such as bonds with embedded options.
Key rate duration (or partial duration)	Sensitivity of a bond's price to a change in a benchmark yield *curve for a specific maturity, while other rates remain the same*	It helps to assess exposure to nonparallel changes in yield curves, where different maturity rates move by different amounts. For example, a bond with a 10-year key rate duration of 7 is expected to fall by approximately 7% when 10-year benchmark yields rise by 1% *while all other maturity rates stay the same.*

Empirical duration	A measure of interest rate sensitivity derived from regressing bond returns versus benchmark yield changes	This is the same interpretation as effective duration; however, it is based on past observed market behavior rather than derived through modeling.
Money duration (or dollar duration)	A measure of the monetary gain or loss expected due to a 1% change in yield, which is calculated as modified duration × market value	A higher money duration implies a larger absolute change in portfolio value (in currency terms) when yields change by 1%.
Price value of a basis point (PVBP) [or "dollar value of an 0.01" (DV01) or basis point value (BPV)]	Money duration × 0.0001	It measures the absolute change in portfolio value (in currency terms) when yields change by 1 basis point.
Convexity	The extent to which the bond's price behavior versus changes in yield is nonlinear (i.e., not a straight line). Convexity is positive for fixed-coupon bonds without embedded options.	Positive convexity implies that a bond price is expected to rise by *more* than that implied by duration alone when yields fall and fall by *less* than that implied by duration alone when yields rise.
Effective convexity	Measures the extent of a *nonlinear* relationship between a bond's price and changes in a benchmark yield curve, based on directly modeling changes in prices due to changes in a benchmark curve	Effective convexity is used for complex bonds where cash flows are not certain, such as bonds with embedded options.

Some key facts to consider include the following:

- Convexity is valuable to bondholders when yields are expected to change. This is because positive convexity, as just described, implies that a bond price is expected to rise by *more* than that implied by duration alone when yields fall and fall by *less* than that implied by duration alone when yields rise. Note that this will mean investors will pay higher prices for higher convexity bonds (and accept lower yields vs. yields of other less convex bonds).
- Convexity is often referred to as a second order measure—meaning that it measures how much the sensitivity of price versus yield *changes* as yields change. As a second order measure, it is approximately proportional to duration squared —in other words, a bond with a duration of 20 years will have approximately four times the convexity of a bond with a duration of 10 years (because 20 squared is four times 10 squared).
- Convexity is directly related to the *dispersion* of cash flows in time around the Macaulay duration of the bond. For a given Macaulay duration, the lowest convexity bond will be a zero-coupon bond with one cash flow at maturity.

Fixed-Income Portfolio Measures

When combining bonds together in a portfolio, the following apply:

- The Macaulay duration of a portfolio is the weighted average time to receive the cash flows of the portfolio. It is commonly estimated as the cash-weighed duration of the individual assets in the portfolio (note that this applies to all basic duration

measures). For example, if 40% of a portfolio is invested in a bond with a duration of 10 and the remaining 60% of the portfolio is invested in a bond with a duration of 15, the portfolio duration is estimated as (0.4 × 10) + (0.6 × 15) = 13.

- The modified duration and convexity of a portfolio is estimated as the cash-weighted convexity of the individual assets in the portfolio, similar to the process for the Macaulay duration just described.
- The effective duration and effective convexity of a portfolio are calculated using the following formulas:

$$\text{effective duration} = \frac{(PV_-) - (PV_+)}{2(\Delta\text{curve})(PV_0)}$$

$$\text{effective convexity} = \frac{(PV_-) + (PV_+) - 2(PV_0)}{(\Delta\text{curve})^2(PV_0)}$$

where:

PV_0 = current value of the portfolio

PV_- = value of portfolio when benchmark curve is shifted down

PV_+ = value of portfolio when benchmark curve is shifted up

Δcurve = change in benchmark curve

- **Spread duration** measures a portfolio's percentage sensitivity to a 1% change in *credit spreads*.
- **Duration times spread (DTS)** is equal to spread duration multiplied by the bonds' credit spread. This measure adjusts spread duration to give a higher sensitivity to spread changes when spreads themselves are higher. This adjustment reflects the empirically observed behavior that bonds with higher spreads are expected to have higher spread *changes* (i.e., spread changes tend to be proportional to current spread levels, rather than the same in absolute term across bonds with different spreads).

Fixed-income managers would use these measures just listed to actively manage a fixed-income portfolio as follows:

- A manager expecting interest rates to fall would increase the duration of their portfolio in order to increase the amount by which their bond prices rise. Conversely, a manager who expected rates to rise would lower the duration of their portfolio.
- A manager who expects credit spreads to narrow would increase the spread duration of their portfolio in order to increase the amount by which their bond price rises. They may also lower the credit rating of the bonds held in the portfolio. Conversely, a manager who expects spreads to widen would decrease the duration of their portfolio or increase the average credit rating of their holdings.
- A manager can use **relative value** techniques to rank individual bonds based on valuation, issuer characteristics, and technical market conditions, so that they can select the best bond to reflect their market view. For example, a manager who expects spreads to narrow can use relative value techniques to select the best

bonds (according to their selection criteria) with a DTS greater than that of the benchmark.

Correlations Between Fixed-Income Sectors

Correlations between bonds in the same market are likely to be high due to the similar overarching macroeconomic conditions that apply to all bonds in the market.

Returns on investment-grade bonds with low credit risk are likely to be primarily driven by changes in the benchmark sovereign yield curve. High-yield bonds, however, are more likely to be affected by changes in spread than benchmark rates. There is likely a negative relationship between benchmark rates and spreads, because in poor economic conditions, interest rates will likely be low but credit spreads high (and vice versa). For this reason, high-yield securities are likely to exhibit higher correlations with equity.

Bond Liquidity

LOS 9.c: Describe bond market liquidity, including the differences among market sub-sectors, and discuss the effect of liquidity on fixed-income portfolio management.

Liquidity is the ability to make transactions in relatively large size, quickly, and with minimal deviation from the market price of the asset. In the bond market, the most recently issued (on-the-run) developed-market government bonds are likely to be quite liquid and other bonds may be quite illiquid. Those other bonds may trade virtually never or at very wide bid-ask spreads. Issues leading to illiquidity include:

- The very large number of bond issues, each of which can be quite small, compared to the smaller number of stock issues in the equity market. A single issuer can have dozens or more separate bonds outstanding. Each can be unique in terms of maturity, coupon, and call features. Each issuer's bonds are heterogeneous (different), unlike the stock of the issuer, which is homogeneous. Most issuers have one class of common stock (and perhaps none, one, or a few issues of preferred stock).
- Bonds usually trade over the counter, which increases the search cost to find a counterparty to any transaction. This also makes transactions less transparent (it is harder to find information on past price and volume of transactions). Bond liquidity is usually higher for recently issued bonds as dealers may have an inventory of those bonds on hand. As time passes, the bonds are likely to become held in portfolios of investors with no plans to trade the bonds. When the issuer puts out a new issue of similar remaining maturity to a previous issue, the older issue becomes off-the-run and its liquidity decreases. The less liquid issues normally trade at a higher yield to maturity, offering a liquidity premium. These liquidity premiums can vary widely depending on specific circumstances.

PROFESSOR'S NOTE

Some authors refer to an illiquidity premium and others to a liquidity premium. They mean the same thing. The current Level III fixed-income

readings call it a liquidity premium, meaning extra compensation in the form of higher yield for lack of liquidity. Remember that as liquidity and the ability to execute transactions at reasonable prices decrease, the liquidity (or illiquidity) premium and yield increase.

Liquidity varies widely by bond market subsector. Generally:

- Liquidity for on-the-run high-quality sovereign government debt is high and declines somewhat for older off-the-run issues. These sovereign government bonds are usually large in size, more homogeneous, and often used as benchmarks for pricing other bonds and as collateral in the repo market (an issue discussed later).
- Corporate bonds are far more varied in credit quality and size of issue. Liquidity typically declines with lower quality as the bonds become riskier and with smaller size of the issue. Size can be an important factor as it takes roughly the same commitment of resources to analyze a large or small issuer, but with smaller issuers it is more difficult to acquire a large holding for the portfolio. Small issuers may also be excluded from bond indexes.

Effects of Liquidity on Bond Portfolio Management

- *Pricing data*. Historically bonds trade over the counter with past price and value information not reported. This makes it difficult to find pricing information. Some countries have moved towards centralized collection and reporting of this trade information, increasing market transparency. In the absence of such reporting or with infrequent trading of a bond issue, pricing information may be based on out-of-date trade prices. Instead of using old prices, bond pricing is often based on **matrix pricing**. Information is gathered on recent trades of bonds with similar features (maturity, quality, and coupon). The YTM of those trades is used to calculate the inferred market price of similar bonds.
- *Portfolio construction*. Buy-and-hold investors have less need for liquidity as they have no plans to sell the bonds; thus, they may prefer to select less liquid bonds in exchange for higher yield. In contrast, active investors and traders will prefer more liquid bonds, reasoning their active management strategies will generate additional return and compensate for lower initial yield. Other investors who anticipate the possibility of needing to sell bonds before maturity to meet unexpected needs may tend to avoid less liquid bonds such as longer maturity and smaller issuers or private placements. The cost of crossing a bid-ask yield spread can be approximated as bond duration × (ask yield – bid yield). For example, a manager trading in a bond with a duration of 10 and a bid-ask spread of 20 bps would suffer costs of 10 × 0.002 = 0.02, or 2%, if they bought the bond at the ask and immediately sold the bond at the bid.
- The fact that most bond trading is done in dealer markets leads less liquid bonds to trade at higher bid-ask spreads. Dealers will reason that if they purchase such bonds, it will take longer to then resell them. Thus, dealers will widen the bid-ask to earn greater expected compensation for holding less liquid bonds in inventory.

Alternatives to Direct Investment in Bonds

PROFESSOR'S NOTE

There is no direct LOS on this next section, but you will recognize topics that are covered elsewhere, so we include a brief summary. These indirect investments are typically more liquid than the underlying bonds.

- Fixed-income exchange-traded funds (ETFs) replicate many sectors of the fixed-income market. The shares are listed on an exchange and therefore easily traded throughout the trading day and have high liquidity.
- Open-end mutual funds offer the ability to subscribe to and redeem fund units on a daily basis and provide diversification and economies of scale that smaller investors would not be able to achieve directly in bond markets.
- Derivatives include exchange-traded bond futures and options and OTC instruments such as interest rate swaps and total return swaps (TRS). Under a TRS, one party (the *total return receiver*) pays an interest rate plus a spread in return for the total return on a reference bond portfolio. An investor might prefer to receive the total return of a bond portfolio under a TRS because the contract will likely only require a relatively small amount of capital to be posted as collateral versus fully funding an ETF position. Drawbacks of using a TRS to access bond market returns include facing the counterparty risk of the total return payer, the rollover risk of renewing contracts when reaching maturity, and potential regulatory reform requiring higher collateral and increasing the costs of such contracts.

MODULE QUIZ 9.1

1. A credit analyst is evaluating the potential for fixed-income securities to provide an inflation hedge. Which of the following types of securities protects both the bond coupon and notional principal amounts from inflation?
   A. Fixed-coupon bonds.
   B. Inflation-linked bonds.
   C. Floating-coupon bonds.

2. A fixed-income portfolio manager is seeking to outperform the Barclays Capital Aggregate Bond Index. Which of the following statements *most accurately* describes a pure indexing strategy for achieving the total-return mandate? Pure bond indexing:
   A. allows large deviations from the risk factors of the index and seeks a high active return.
   B. matches duration to the index, but some risk mismatches of sectors and quality are allowed.
   C. seeks to exactly match all the risk factors of the index while allowing the manager some leeway on the individual bonds selected.

3. Regarding the varying liquidity characteristics among bond market subsectors, which of the following bond issues would typically lead to higher levels of liquidity?
   A. Issuing a small corporate bond issue.
   B. Issuing on-the-run sovereign government debt.
   C. Issuing a corporate bond that is below investment grade.

MODULE 9.2: MODELING RETURN

Video covering this content is available online.

LOS 9.d: Describe and interpret a model for fixed-income returns.

Expected fixed-income return can be viewed as having five components. These components could be projected to calculate expected return or calculated after the fact to decompose sources of return actually earned. The following example explains this approach and the required calculations. While it appears formidable in aggregate, it is a combination of simple time value of money calculations and bond math concepts covered at earlier levels. For a bond portfolio, it uses aggregate portfolio data and that aggregation is provided. Otherwise, there is too much weighted average calculating to be practical without access to spreadsheets.

EXAMPLE: Expected return of a bond portfolio

A fixed-income strategist wishes to forecast the expected return of a bond portfolio for the next year. She gathers the following information and assumes no reinvestment of cash flow:

Par value (notional principal) in millions	50
Average coupon rate of portfolio	3.0%
Coupon frequency	Semiannual
Horizon analysis	1 year
Average bond price of portfolio	101.500
Projected bond price in one year if yield curve is unchanged	102.419
Average bond convexity (C) of portfolio	28
Average bond duration (modified duration or MD) of portfolio	5.60
Expected average benchmark YTM change	–0.54%
Expected change in spread	–0.06%
Expected gains or losses versus investor's currency (for 40% of portfolio allocated to foreign bonds)	+3.925%

Projected return:

Component 1, **coupon income**:

> annual coupon payment / current bond portfolio price = 3.0 / 101.50 = 2.956%

Because this example assumes no cash-flow reinvestment, it does not matter that the coupons are paid semiannually. With a 3.0% annual coupon rate, 1.50 will be received in 6 and 12 months for total coupons collected of 3.00 per 100 par. Collected coupon amount divided by initial price is the coupon income of the portfolio, sometimes referred to as current yield.

Component 2, **rolldown return**:

This is a projection of the bond prices in the portfolio assuming the yield curve is unchanged. For example, suppose the portfolio were made up only of a 7-year bond priced to yield 2.76% with a price of 101.50. Further assume the initial yield curve is upward sloping and the 6-year bond yields 2.56%. A bond pricing model could be used to project the price of the 7-year bond in one year when it is a 6-year bond priced at a 2.56% yield. (Note that this is not necessarily a simple analysis for a portfolio of bonds and would have to be done bond by bond and

then aggregated. That is why it is a given value in the data provided). The rolldown return is calculated as follows:

(end of horizon period projected price – beginning price) / beginning price = (102.419 – 101.50) / 101.50 = 0.905%

Note that if the yield curve is flat and a bond is initially priced at a premium (discount) to par, the projected price at end of period will be lower (higher) than the start-of-period price as the bond's price is pulled to par at expiration. With a sloped yield curve, that may not always be true in the shorter run (before maturity). It is true that if the yield curve is upward (downward) sloping, the rolldown return will be higher (lower) than the start-of-period YTM because the bond will decline in the remaining term to maturity over the horizon period and be priced at a lower (higher) YTM at the end of that period.

Components 1 and 2 are sometimes combined and called the **rolling yield**:

2.956 + 0.905 = 3.86%

Component 3, **expected price change due to change in benchmark yield (ΔY)**:

Let's assume the projected price based on rolldown of 102.419 is in fact an aggregate portfolio benchmark yield (YTM) of 2.56%. The analyst then projects a 54-basis-point decline in yields versus the 2.56% yield used in the rolldown calculation. Expected price change is calculated from the investor's expected change in benchmark yield using the portfolio's duration and convexity:

$(-MD \times \Delta Y) + (\frac{1}{2} \times C \times \Delta Y^2) = (-5.6 \times -0.0054) + [\frac{1}{2} \times 28 \times (-0.0054)^2] = 0.03024 + 0.00041 = 3.065\%$

Notice that the convexity effect is very small and only adds 0.041% to the return. Convexity is a second-order effect and is often insignificant for option-free bonds unless the ΔY is very large. If the portfolio includes bonds with embedded options, then effective duration and effective convexity must be used. Floating-rate securities would also complicate the analysis, as their duration is low, but will still have a sensitivity to changes in spreads, as discussed next.

Component 4, **expected price change due to change in credit spreads (ΔS)**:

The analyst also projects a 6-basis-point narrowing of spreads over the investment horizon. This change in spread is assumed to flow through to change the bond's yield. The impact of this change in spread on the bond's price can be calculated in a similar way to the duration and convexity formula used in the previous component:

$(-MD \times \Delta S) + (\frac{1}{2} \times C \times \Delta S^2) = (-5.6 \times -0.0006) + [\frac{1}{2} \times 28 \times (-0.0006)^2] = 0.00336 + 0.000005 = 0.337\%$

Component 5, **expected gains or losses versus investor's currency**:

The portfolio is invested 40% in foreign denominated bonds, and the investor expects the foreign currencies (weight to reflect portfolio exposures) to appreciate 3.925%, giving the portfolio an expected gain of 3.925% × 0.40 = 1.570%.

In summary, the projected bond return is the sum of these:

1. Coupon income: annual coupon amount / current bond price
   3.0 / 101.50 = 2.956%