READING

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Overview of Fixed-Income Portfolio Management

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LEARNING OUTCOMES

Mastery	*The candidate should be able to:*
☐	**a.** discuss roles of fixed-income securities in portfolios;
☐	**b.** describe how fixed-income mandates may be classified and compare features of the mandates;
☐	**c.** describe bond market liquidity, including the differences among market sub-sectors, and discuss the effect of liquidity on fixed-income portfolio management;
☐	**d.** describe and interpret a model for fixed-income returns;
☐	**e.** discuss the use of leverage, alternative methods for leveraging, and risks that leverage creates in fixed-income portfolios;
☐	**f.** discuss differences in managing fixed-income portfolios for taxable and tax-exempt investors.

INTRODUCTION

1

Globally, fixed-income markets represent the largest asset class in financial markets, and most investors' portfolios include fixed-income investments. Fixed-income markets include publicly traded securities (such as commercial paper, notes, and bonds) and non-publicly traded instruments (such as loans and privately placed securities). Loans may be securitized and become part of the pool of assets supporting an asset-backed security.

This reading discusses why investor portfolios include fixed-income securities and provides an overview of fixed-income portfolio management. Section 2 discusses different roles of fixed-income securities in portfolios, including diversification, regular cash flows, and inflation hedging potential. Section 3 describes the two main types of fixed-income portfolio mandates: liability-based (or structured) mandates and

total return mandates. It also describes approaches to implementing these mandates. Section 4 discusses bond market liquidity and its effects on pricing and portfolio construction. Section 5 introduces a model of how a bond position's total expected return can be decomposed. The model provides a better understanding of the driving forces behind expected returns to fixed-income securities. Section 6 discusses the use of leverage in fixed-income portfolios. Section 7 describes considerations in managing fixed-income portfolios for both taxable and tax-exempt investors. A summary of key points completes the reading.

2 ROLES OF FIXED-INCOME SECURITIES IN PORTFOLIOS

Fixed-income securities serve important roles in investment portfolios, including diversification, regular cash flows, and possible inflation hedging. The correlations of fixed-income securities with equity securities vary, but adding fixed-income securities to portfolios that include equity securities is usually an effective way to obtain diversification benefits. Fixed-income securities typically specify schedules for principal repayments and interest payments. The scheduled nature of their cash flows enables investors—both individual and institutional—to fund, with some degree of predictability, known future obligations such as tuition payments or corporate pension obligations. Some fixed-income securities, such as inflation-linked bonds, may also provide a hedge for inflation.

2.1 Diversification Benefits

In a portfolio context, fixed-income investments can provide diversification benefits when combined with other asset classes. Recall that a major reason that portfolios can effectively reduce risk is that combining securities whose returns are not perfectly correlated (i.e., a correlation coefficient of less than +1.0) provides risk diversification. Lower correlations are associated with lower risk. The challenge in diversifying risk is to find assets that have a correlation that is much lower than +1.0.

Exhibit 1 shows the correlation matrix across several bond market sectors and the S&P 500 Index (an index of large-cap US equity securities) for the period January 2003 to September 2015. The bond market sectors in the matrix are represented by indexes of four investment-grade bond sub-sectors of the US bond market:

1. The Bloomberg Barclays US Aggregate (US dollar–denominated bonds with maturity greater than 1 year, including Treasuries, government-related and corporate securities, mortgage-backed securities, asset-backed securities, and commercial mortgage-backed securities);
2. The Bloomberg Barclays US Treasury Bond 10-Year Term (US Treasury bonds with maturities of 7–10 years);
3. The Bloomberg Barclays US Corporate (US dollar–denominated corporate bonds with maturity greater than 1 year); and
4. The Bloomberg Barclays US TIPS (Series-L) (US Treasury Inflation-Protected Securities [TIPS] with maturity greater than 1 year).

In addition to investment-grade bonds, the matrix includes a high-yield (non-investment-grade) bond market index: the Bloomberg Barclays US Corporate High-Yield (US dollar–denominated high-yield corporate bonds with maturity greater than

one year). The matrix also includes two international bond indexes: the Bloomberg Barclays Global Aggregate (international investment-grade bonds) and the JP Morgan Government Bond Index–Emerging Markets Global (GBI–EM Global).

Exhibit 1 Correlation Matrix

Index	Bloomberg Barclays US Aggregate	Bloomberg Barclays US Treasury 10-Year Term	Bloomberg Barclays US Corporate	Bloomberg Barclays US TIPS	Bloomberg Barclays Global Aggregate	Bloomberg Barclays US Corporate High Yield	JP Morgan GBI-EM Global	S&P 500
Bloomberg Barclays US Aggregate	1.00	0.95	0.92	0.81	0.54	0.03	−0.01	−0.27
Bloomberg Barclays US Treasury 10-Year Term	0.95	1.00	0.88	0.79	0.50	−0.13	−0.12	−0.35
Bloomberg Barclays US Corporate	0.92	0.88	1.00	0.77	0.50	0.16	0.04	−0.25
Bloomberg Barclays US TIPS	0.81	0.79	0.77	1.00	0.49	0.07	0.08	−0.21
Bloomberg Barclays Global Aggregate	0.54	0.50	0.50	0.49	1.00	0.09	0.46	0.04
Bloomberg Barclays US Corporate High Yield	0.03	−0.13	0.16	0.07	0.09	1.00	0.47	0.32
JP Morgan GBI-EM Global	−0.01	−0.12	0.04	0.08	0.46	0.47	1.00	0.36
S&P 500	−0.27	−0.35	−0.25	−0.21	0.04	0.32	0.36	1.00

Source: Authors' calculations for the period January 2003 to September 2015, based on data from Barclays Risk Analytics and Index Solutions; J.P. Morgan Index Research; S&P Dow Jones Indices.

For the period January 2003 to September 2015, the correlation matrix shows the following:

- The US bond market's investment-grade sub-sectors were highly correlated with each other, as evidenced by the correlations ranging from 0.77 to 0.95.
- International investment-grade bonds, which include US investment-grade bonds, show a 0.54 correlation with the overall US investment-grade bond sector. Because the US Aggregate Index and the US Aggregate Index portion of the Global Aggregate Index have a correlation of 1.0, the non-US investment-grade bonds must have had an even lower correlation with US investment-grade bonds. During this period, significant diversification benefits existed for including both US and non-US bonds in portfolios.

- The US investment-grade bond sub-sectors exhibited low (and in some cases, negative) correlations with equities, US high-yield bonds, and emerging market bonds. International investment-grade bonds also exhibited low correlations with equities and US high-yield bonds but were moderately correlated with emerging market bonds. The low or negative correlations indicate that investment-grade bonds would have provided significant diversification benefits if combined with these other, more-volatile asset classes.
- High-yield bonds, emerging market bonds, and equities exhibited positive correlations with each other, ranging from 0.32 to 0.47.

Based on Exhibit 1, it appears that combining investment-grade, high-yield, and emerging market bonds and equities can result in portfolio diversification benefits. Fixed-income investments may also provide diversification benefits through their low correlations with other asset classes, such as real estate and commodities.

Importantly, these correlations are not constant over time. During a long historical period, the average correlation of returns between two asset classes may be low, but in any particular period, the correlation can differ from the average correlation. Correlation estimates can vary based on the capital market dynamics during the period when the correlations are measured. The correlation between the asset classes may increase or decrease, depending on the circumstances. During periods of market stress, investors may exhibit a "flight to quality" by buying safer assets such as government bonds (increasing their prices) and selling riskier assets such as equity securities and high-yield bonds (lowering their prices). These actions may decrease the correlation between government bonds and equity securities, as well as between government bonds and high-yield bonds. At the same time, the correlation between riskier assets such as equity securities and high-yield bonds may increase.

Correlation among assets is the primary determinant of diversification benefits and a reduction in portfolio risk, but volatility of each asset class also affects portfolio risk. Bonds are generally less volatile than other major asset classes such as equity securities. Consider the standard deviation of daily returns to the indexes shown in Exhibit 1, covering the same period (January 2003 to September 2015). The Bloomberg Barclays US Aggregate (Bond) Index exhibited annualized return standard deviations of approximately 4%. The Bloomberg Barclays US Corporate High-Yield Index and the JP Morgan GBI–EM Index, which are higher-risk sectors of the bond market, exhibited 6.3% and 9.8% annualized return standard deviations, respectively. By comparison, the S&P 500 exhibited an annualized return standard deviation of 19.4%. Including diversified fixed-income positions in an investment portfolio, combined with exposure to other major asset classes, may significantly lower portfolio risk.

It is important to note that similar to correlations, volatility (standard deviation) of asset class returns may also vary over time. If interest rate volatility increases, bonds, particularly those with long maturities, can exhibit higher near-term volatility relative to the average volatility during a long historical period. The standard deviation of returns for lower credit quality (high-yield) bonds can rise significantly during times of financial stress, because as credit quality declines and the probability of default increases, investors often view these bonds as being more similar to equities.

2.2 Benefits of Regular Cash Flows

Fixed-income investments typically produce regular cash flows to a portfolio. Regular cash flows allow investors—both individual and institutional—to plan how to meet, with some degree of predictability, known future obligations such as tuition payments, pension obligations, or payouts on life insurance policies. In these cases, future liabilities can be estimated with some reasonable certainty. Fixed-income securities are often

acquired and "dedicated" to funding those future liabilities. In dedicated portfolios, fixed-income securities are selected such that the timing and magnitude of their cash flows match the timing and magnitude of the projected future liabilities.

Frequently, investors will "ladder" bond portfolios by staggering the maturity dates of portfolio bonds throughout the investment horizon. This approach can help to balance price risk and reinvestment risk. Buy-and-hold portfolios can also be tailored to fit an investor's specific investment horizon. For example, if an investor seeks regular income over a 10-year horizon, coupon-paying bonds that mature approximately 10 years in the future are good building blocks for such a portfolio.

It is important to note that reliance on regular cash flows assumes that no credit event (such as an issuer missing a scheduled interest or principal payment) or other market event (such as a decrease in interest rates increasing prepayments of mortgages underlying mortgage-backed securities) will occur. These events may cause actual cash flows of fixed-income securities to differ from expected cash flows. If any credit or market event occurs, a portfolio manager may need to adjust the portfolio.

2.3 Inflation Hedging Potential

Some fixed-income securities can provide a hedge for inflation. Bonds with floating-rate coupons protect interest income from inflation because the reference rate should adjust for inflation. The principal payment at maturity is unadjusted for inflation. Inflation-linked bonds provide investors with valuable inflation hedging benefits by paying a return that is directly linked to an index of consumer prices and adjusting the principal for inflation. There are several different structures for inflation-linked bonds, such as zero-coupon bonds with the inflation adjustment made to the principal payment, and capital-indexed bonds where a fixed coupon rate is applied to a principal amount that is adjusted for inflation throughout the bond's life.

The return on inflation-linked bonds includes a real return plus an additional component that is tied directly to the inflation rate. Inflation-linked bonds typically exhibit lower return volatility than conventional bonds and equities because the volatility of the returns on inflation-linked bonds depends on the volatility of *real,* rather than *nominal,* interest rates. The volatility of real interest rates is typically lower than the volatility of nominal interest rates that drive the returns of conventional bonds and equities.

Many governments in developed countries have issued inflation-linked bonds, including the United States, United Kingdom, France, Germany, Sweden, and Canada, as well as some in developing countries such as Brazil, Chile, and Argentina. Corporate issuers of inflation-linked bonds have included both financial and non-financial companies. For investors with long investment horizons, especially institutions facing long-term liabilities (for example, defined benefit pension plans and life insurance companies), inflation-linked bonds are particularly useful.

Exhibit 2 illustrates inflation protection provided by type of bond.

Exhibit 2 Protection against Inflation

	Coupon	Principal
Fixed-coupon bonds	Inflation unprotected	Inflation unprotected
Floating-coupon bonds	Inflation protected	Inflation unprotected
Inflation-linked bonds	Inflation protected	Inflation protected

Adding inflation-indexed bonds to diversified portfolios of bonds and equities typically results in superior risk-adjusted real portfolio returns. This improvement occurs because inflation-linked bonds can effectively represent a separate asset class, as they offer returns that differ from other asset classes and add to market completeness. Introducing inflation-linked bonds to an asset allocation strategy can result in a superior mean-efficient frontier.

EXAMPLE 1

Adding Fixed-Income Securities to a Portfolio

Mary Baker is anxious about the level of risk in her portfolio based on a recent period of increased equity market volatility. Most of her wealth is invested in a diversified global equities portfolio.

Baker contacts two wealth management firms, Atlantic Investments (AI) and West Coast Capital (WCC), for advice. In conversation with each adviser, she expresses her desire to reduce her portfolio's risk and to have a portfolio that generates a cash flow stream with consistent purchasing power over her 15-year investment horizon.

The correlation coefficient of Baker's diversified global equities portfolio with a diversified fixed-coupon bond portfolio is –0.10 and with a diversified inflation-linked bond portfolio is 0.10. The correlation coefficient between a diversified fixed-coupon bond portfolio and a diversified inflation-linked bond portfolio is 0.65.

The adviser from AI suggests diversifying half of her investment assets into nominal fixed-coupon bonds. The adviser from WCC also suggests diversification but recommends that Baker invest 25% of her investment assets into fixed-coupon bonds and 25% into inflation-linked bonds.

Evaluate the advice given to Baker by each adviser based on her stated desires regarding portfolio risk reduction and cash flow stream. Recommend which advice Baker should follow, making sure to discuss the following concepts in your answer:

a Diversification benefits

b Cash flow benefits

c Inflation hedging benefits

Solution:

Advice from AI:

Diversifying into fixed-coupon bonds would offer substantial diversification benefits in lowering overall portfolio volatility (risk) given the negative correlation of –0.10. The portfolio's volatility, measured by standard deviation, would be lower than the weighted standard deviations of the diversified global equities portfolio and the diversified fixed-coupon bond portfolio. The portfolio will generate regular cash flows because it includes fixed-coupon bonds. This advice, however, does not address Baker's desire to have the cash flows maintain purchasing power over time and thus serve as an inflation hedge.

Advice from WCC:

Diversifying into both fixed-coupon bonds and inflation-linked bonds offers additional diversification benefits beyond that offered by fixed-coupon bonds only. The correlation between diversified global equities and inflation-linked bonds is only 0.10. The correlation between nominal fixed-coupon bonds and

inflation-linked bonds is 0.65, which is also less than 1.0. The portfolio will generate regular cash flows because of the inclusion of fixed-coupon and inflation-linked bonds. Adding the inflation-linked bonds helps to at least partially address Baker's desire for consistent purchasing power over her investment horizon.

Based on her stated desires and the analysis above, Baker should follow the advice provided by WCC.

FIXED-INCOME MANDATES

3

The previous section discussed the roles of fixed-income securities in portfolios and the benefits these securities provide. When investment mandates include an allocation to fixed income, investors need to decide how to add fixed-income securities to portfolios. Fixed-income mandates can be broadly classified into liability-based mandates and total return mandates. Liability-based mandates are managed to match or cover expected liability payments with future projected cash inflows. As such, they are also referred to as structured mandates, asset/liability management (ALM), or liability-driven investments (LDI). These types of mandates are structured in a way to ensure that a liability or a stream of liabilities (e.g., a company's pension liabilities) can be covered and that any risk of shortfalls or deficient cash inflows is minimized.

Total return mandates are generally managed in an attempt to either track or outperform a market-weighted fixed-income benchmark such as the Bloomberg Barclays Global Aggregate Index. Both liability-based and total return mandates exhibit common features, such as the attempt by investors to achieve the highest risk-adjusted returns (or perhaps highest yields) given a set of constraints. The two types of mandates have fundamentally different objectives, however.

Some fixed-income mandates include a requirement that environmental, social, and governance (ESG) factors are considered during the investment process. When considering these factors, an analyst or portfolio manager may look for evidence on whether the portfolio contains companies whose operations are favorable or unfavorable in the context of ESG, and whether such companies' actions and resource management practices reflect a sustainable business model. For example, the analyst or portfolio manager may consider whether a company experienced incidents involving significant environmental damage, instances of unfair labor practices, or lapses in corporate governance integrity. For companies that do not fare favorably in an ESG analysis, investors may assume that these companies are more likely to encounter future ESG-related incidents that could cause serious reputational and financial damage to the company. Such incidents could impair a company's credit quality and result in a decline in both the price of the company's bonds and the performance of a portfolio containing those bonds.

3.1 Liability-Based Mandates

Users of liability-based mandates include individuals funding specific cash flow and lifestyle needs as well as institutions such as banks, insurance companies, and pension funds. These types of institutions have a need to match future liabilities, such as payouts on life insurance policies and pension benefits, with corresponding cash inflows. Pension funds are perhaps the largest users of liability-based mandates based on assets invested. Regulators in many jurisdictions impose minimum funding levels on pension liabilities to ensure the safety of retiree pensions. Insurance companies

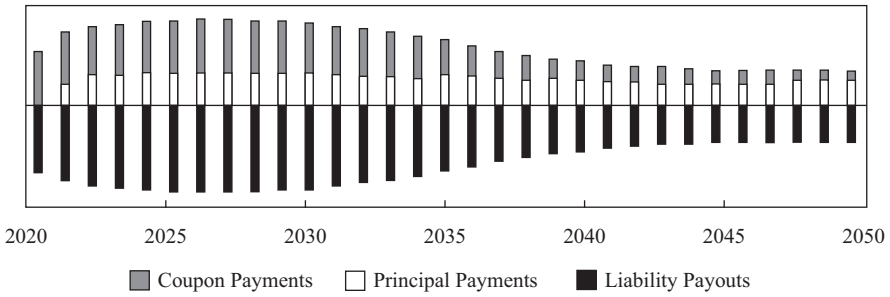
project future cash outflows based on expected claims from policyholders. Additionally, life insurance companies may offer annuities and guaranteed investment contracts, both of which require cash outflows for extended periods.

There are two main approaches to liability-based mandates: **cash flow matching** and **duration matching**, which are immunization approaches. Immunization is the process of structuring and managing a fixed-income portfolio to minimize the variance in the realized rate of return over a known time horizon. This variance arises from the volatility of future interest rates. Immunization is an asset/liability management approach that structures investments in bonds to reduce or eliminate the risks associated with a change in market interest rates. In addition, several variations use or combine elements of these approaches, including contingent immunization and horizon matching.[1] The following discussion provides an overview of these approaches.

3.1.1 *Cash Flow Matching*

Cash flow matching is an immunization approach that may be the simplest and most intuitive way to match a liability stream and a stream of cash inflows. This approach, unlike duration matching, essentially has no underlying assumptions. Cash flow matching attempts to ensure that all future liability payouts are matched precisely by cash flows from bonds or fixed-income derivatives, such as interest rate futures, options, or swaps. Exhibit 3 shows the results of a cash flow matching approach for a liability stream and a bond portfolio. Future liability payouts are exactly mirrored by coupon and principal payments arising from the bond portfolio. Bond cash inflows coincide with liability cash outflows. Therefore, there is no need for reinvestment of cash inflows.

Exhibit 3 Cash Flow Matching



In practice, perfect matching of cash flows is difficult to achieve. It is rare that a combination of fixed-income securities can be found that exactly matches the timing and amount of the required cash outflows. Further, implementing a cash flow matching approach may result in relatively high transaction costs, even if quantitative optimization techniques are used to construct a cash flow matching portfolio at the lowest possible cost. Timing mismatches, such as some cash inflows preceding corresponding cash outflows, tend to exist because it may be less costly and more practical to not match cash flows precisely. Such a mismatch, however, results in some reinvestment risk.

Although in theory a cash flow matching portfolio does not need to be rebalanced once in place, it is often desirable or necessary to do so. As market conditions change, the lowest-cost cash flow matching portfolio may change because the universe of

1 Leibowitz (1986a and 1986b) provides an insightful summary of the main approaches.

securities eligible for inclusion into the portfolio changes and the characteristics of securities change. A portfolio manager, therefore, has an incentive to rebalance the portfolio periodically despite incurring transaction costs.

For some types of fixed-income securities, the timing or amount of cash flows may change. For example, a corporate bond issuer may default and subsequent cash flows cease, or a bond with an embedded option may be called before maturity. Although these types of "imperfections" can often be avoided by restricting the universe of eligible securities and including only certain types of bonds (e.g., government bonds) in the portfolio, it is usually not optimal to do so. Securities that are not included in a smaller restricted universe might provide better return-to-risk tradeoffs.

3.1.2 *Duration Matching*

Duration matching is an immunization approach that is based on the duration of assets and liabilities. Ideally, the liabilities being matched (the liability portfolio) and the portfolio of assets (the bond portfolio) should be affected similarly by a change in interest rates. Conditions that need to be satisfied to achieve immunization using duration matching include the following: (1) A bond portfolio's duration must equal the duration of the liability portfolio; and (2) the present value of the bond portfolio's assets must equal the present value of the liabilities at current interest rate levels. The idea is that changes in the bond portfolio's market value closely match changes in the liability portfolio, whether interest rates rise or fall.

If interest rates increase or decrease, changes in reinvestment income and changes in bond prices immunize against the effect of interest rate changes. If interest rates decrease, reduced reinvestment income is offset by an increase in bond prices. If interest rates increase, higher reinvestment income offsets the decrease in bond prices. A crucial limitation of immunization is that it protects against only a parallel change in the yield curve—that is, the same yield change across the entire maturity spectrum of the yield curve. In practice, however, changes in the bond market environment may lead to changes in yield curve shape, such as steepening, flattening, or changes in the curvature.[2] Hence immunization remains imperfect, and the strategy design needs to incorporate some margin for error.

It is important to note other considerations for an immunized portfolio:

- A portfolio is an immunized portfolio only at a given point in time. As market conditions change, the immunization conditions will be violated, and the portfolio therefore needs to be rebalanced periodically to continue to achieve its immunization objective.
- The need to rebalance makes liquidity considerations important. Moreover, if bond portfolio cash flows (e.g., scheduled coupon and principal payments) are not perfectly matched with liability cash flows under immunization, bond positions may need to be liquidated in order to satisfy the liability outflows.
- Rebalancing and the need to liquidate positions can result in high portfolio turnover.

2 There are extensions to the classical immunization approach (Redington 1952) that can incorporate nonparallel yield curve shifts (see, for example, Fong and Vasicek 1984). These approaches are more complex, however, and are not discussed here.

- Immunization assumes that bond issuers do not default, and it does not protect against issuer- or bond-specific interest rate changes such as those resulting from an individual bond issuer's change in credit quality.
- Immunization can accommodate bonds with embedded options (such as certain corporate bonds and mortgage-backed securities) to the extent that a bond's duration is replaced by its effective duration as an input to the methodology. Effective duration takes into account that future interest rate changes can affect the expected cash flows for a bond with embedded options.

In summary, the duration matching approach requires that reinvestment risk and the risk of bond price movements in a portfolio are offset. In practice, however, some immunization risk almost always remains. An exception would be a portfolio of zero-coupon bonds that are designed to match liability cash flows. In this case, because the zero-coupon bonds are held to maturity, the effect of interest rate changes on price are irrelevant and there are no interim cash flows to reinvest. In effect, there is no price risk, no reinvestment risk, and therefore no immunization risk, although credit risk remains.

Exhibit 4 gives an overview of key features of duration matching and cash flow matching.

Exhibit 4 Liability-Based Mandates: Key Features

	Duration Matching	Cash Flow Matching
Yield curve assumptions	Parallel yield curve shifts	None
Mechanism	Risk of shortfall in cash flows is minimized by matching duration and present value of liability stream	Bond portfolio cash flows match liabilities
Basic principle	Cash flows come from coupon and principal repayments of the bond portfolio and offset liability cash flows	Cash flows, coupons, and principal repayments of the bond portfolio offset liability cash flows
Rebalancing	Frequent rebalancing required	Not required but often desirable
Complexity	High	Low

3.1.3 *Contingent Immunization*

Variations of both duration and cash flow matching approaches exist. A commonly used hybrid approach is known as **contingent immunization**, which combines immunization with an active management approach when the asset portfolio's value exceeds the present value of the liability portfolio. In other words, there is a surplus. The portfolio manager is allowed to actively manage the asset portfolio, or some portion of the asset portfolio, as long as the value of the actively managed portfolio exceeds a specified value (threshold). The actively managed portfolio can potentially be invested into any asset category, including equity, fixed-income, and alternative investments. If the actively managed portfolio value falls to the specified threshold, active management ceases and a conventional duration matching or a cash flow matching approach is put in place.

3.1.4 *Horizon Matching*

Another hybrid approach, **horizon matching**, combines cash flow and duration matching approaches. Under this approach, liabilities are categorized as short- and long-term liabilities. The short-term liability portion (usually liabilities up to about

four or five years) is covered by a cash flow matching approach, whereas the long-term liabilities are covered by a duration matching approach. This approach combines desirable features of both approaches—a portfolio manager has more flexibility over the less certain, longer horizon and can still meet more certain, shorter-term obligations.

EXAMPLE 2

Liability-Based Mandates (1)

Dave Wilson, a fixed-income analyst, has been asked by his manager to analyze different liability-based mandates for a pension fund client. The pension plan currently has a very large surplus of assets over liabilities. Evaluate whether an immunization or contingent immunization approach would be most suitable for the pension fund.

Solution:

Because the pension fund currently has a large surplus of assets over liabilities, a contingent immunization approach would be most suitable. A pure immunization approach would not be appropriate, because a key assumption under this approach is that the present value of the fund's assets equals the present value of its liabilities. The contingent immunization approach allows the pension fund's portfolio manager to follow an active management approach as long as the portfolio remains above a specified value. If the pension fund's portfolio decreases to the specified value, a duration matching or even a cash flow matching approach would be put in place to ensure adequate funding of the pension plan's liabilities.

EXAMPLE 3

Liability-Based Mandates (2)

If the yield curve experiences a one-time parallel shift of 1%, what is the likely effect on the match between a portfolio's assets and liabilities for a duration matching approach and a cash flow matching approach?

Solution:

There should be no effect on the match between assets and liabilities for either a duration matching or cash flow matching portfolio. Duration matching insures against any adverse effects of a one-time parallel shift in the yield curve. By contrast, non-parallel shifts would cause mismatches between assets and liabilities in a duration matching approach. In a cash flow matching approach, asset and liability matching remains in place even if market conditions change.

3.2 Total Return Mandates

In contrast to liability-based mandates, total return mandates do not attempt to match future liabilities. Total return mandates can establish objectives based on a specified absolute return or a relative return. Generally structured to either track or outperform a specified bond index, total return mandates are the focus of this discussion. Total return and risk are both critical considerations for these types of mandates, with **active return** and **active risk** representing key metrics. Active return is defined

as the portfolio return minus the benchmark return. Active risk is the annualized standard deviation of active returns, which may also be referred to as **tracking error** (also sometimes called **tracking risk**).

Total return mandates can be classified into different approaches based on their target active return and active risk levels. Approaches range from a pure indexing approach that has targeted active return and active risk (tracking error) of zero to fully active approaches that substantially deviate from the benchmarks and attempt to generate significant excess (or active) returns. Portfolios that attempt to closely match a bond index, as compared with an equity index, are more challenging to construct and monitor.

3.2.1 *Pure Indexing*

A pure indexing approach attempts to replicate a bond index as closely as possible. Under this approach, the targeted active return and active risk are both zero. In practice, even if the tracking error is zero, the portfolio return will almost always be lower than the corresponding index return because of trading costs and management fees. Theoretically, the portfolio should include all of the underlying securities in the same proportions as the index. It is generally very difficult and costly, however, to precisely replicate most bond indexes because many bonds included in standard indexes are illiquid. Illiquidity is typically higher for bonds with small issuance size, less familiarity of the bond issuer among investors, and longer period outstanding. To help deal with bond market illiquidity, portfolio managers are generally allowed some flexibility around index holdings in an attempt to reduce costs and make the portfolio more implementable in practice.

An index manager, who is allowed some flexibility in holdings, is expected to match the risk factor exposures of the benchmark index, such as duration, credit (or quality) risk, sector risk, call risk, and prepayment risk. In this way, all or most of the known systematic risk factors can be matched to the extent possible. The risk that remains is then mostly issuer-specific (or idiosyncratic) risk, which can be largely mitigated if both the benchmark index and the portfolio are sufficiently diversified. Overall, a pure indexing approach that allows some flexibility in holdings is generally less costly and easier to implement than precise replication of an index. Portfolio turnover for pure indexing approaches is normally consistent with benchmark turnover but considerably lower than that of most active management approaches.[3]

3.2.2 *Enhanced Indexing*

An enhanced indexing approach maintains a close link to the benchmark but attempts to generate at least a modest amount of outperformance relative to the benchmark. As with the pure indexing approach in practice, enhanced indexing allows small deviations in portfolio holdings from the benchmark index but tracks the benchmark's primary risk factor exposures very closely (particularly duration). Unlike the pure indexing approach, however, minor risk factor mismatches (e.g., sector or quality bets) are allowed under enhanced indexing. The intent of the mismatches is to generate higher returns than the benchmark. A target active risk or tracking error of less than 50 bps per year is typical. The turnover of this type of approach is generally only marginally higher than that of a pure indexing portfolio. Any potential outperformance of an

3 In general, bond index turnover is considerably higher than equity index turnover. This is true because higher cash flows are received as a result of bonds maturing or being called by issuers and also as a result of coupon payments. Cash flows from equity indexes are typically lower than those of bond indexes, and they mostly come from dividends as well as corporate actions. Bond index turnover depends to a large extent on the index's average maturity as well as its duration. Shorter-term bond indexes incur more-frequent principal repayments as bonds mature, which need to be reinvested in new bonds being added to these indexes. As a result, turnover for shorter-term bond indexes tends to be high.

enhanced indexing approach is likely to be modest. As a result, managers need to monitor turnover and the associated transaction costs closely in order to achieve positive active returns net of fees and costs. Management fees for an enhanced indexing approach are normally higher than those of a pure indexing approach portfolio. The higher fees largely reflect the manager's efforts to outperform the index. Management fees for an enhanced indexing approach are considerably lower than those of a fully active management approach.

3.2.3 *Active Management*

Active management allows larger risk factor mismatches relative to a benchmark index. These mismatches may cause significant return differences between the active portfolio and the underlying benchmark. Most notably, portfolio managers may take views on portfolio duration that differ markedly from the duration of the underlying benchmark. To take advantage of potential opportunities in changing market environments, active managers may incur significant portfolio turnover—often considerably higher than the underlying benchmark's turnover. Active portfolio managers normally charge higher management fees than pure or enhanced index managers. The higher fees and transaction costs increase the rate of return necessary to achieve positive active returns net of fees and costs.

As with enhanced indexing, actively managed portfolios seek to outperform the underlying benchmark. In practice, however, most active managers (in both fixed income and equity) have historically underperformed their benchmarks after fees and transaction costs. Bond index funds have also historically underperformed their benchmark indexes, but to a lesser extent than active fixed-income portfolios, because of lower turnover and management fees in bond index funds. A key challenge for investors is identifying, in advance, portfolio managers that will outperform their benchmarks.

Exhibit 5 summarizes the key features of the total return approaches discussed here.

Exhibit 5 Total Return Approaches: Key Features

	Pure Indexing	Enhanced Indexing	Active Management
Objective	Match benchmark return and risk as closely as possible	Modest outperformance (generally 20 bps to 30 bps) of benchmark while active risk is kept low (typically around 50 bps or lower)	Higher outperformance (generally around 50 bps or more) of benchmark and higher active risk levels
Portfolio weights	Ideally the same as benchmark or only slight mismatches	Small deviations from underlying benchmark	Significant deviations from underlying benchmark
Risk factor matching	Risk factors are matched exactly	Most primary risk factors are closely matched (in particular, duration)	Large risk factor deviations from benchmark (in particular, duration)
Turnover	Similar to underlying benchmark	Slightly higher than underlying benchmark	Considerably higher turnover than the underlying benchmark

EXAMPLE 4

The Characteristics of Different Total Return Approaches

Diane Walker is a consultant for a large corporate pension plan. She is looking at three funds (Funds X, Y, and Z) as part of the pension plan's global fixed-income allocation. All three funds use the Bloomberg Barclays Global Aggregate Index as a benchmark. Exhibit 6 provides characteristics of each fund and the index as of February 2016.

Identify the approach (pure indexing, enhanced indexing, or active management) that is *most likely* used by each fund, and support your choices by referencing the information in Exhibit 6.

Exhibit 6 Characteristics of Funds X, Y, and Z and the Bloomberg Barclays Global Aggregate Index

Risk and Return Characteristics	Fund X	Fund Y	Fund Z	Bloomberg Barclays Global Aggregate Index
Average maturity (years)	8.61	8.35	9.45	8.34
Modified duration (years)	6.37	6.35	7.37	6.34
Average yield (%)	1.49	1.42	1.55	1.43
Convexity	0.65	0.60	0.72	0.60
Quality				
AAA	41.10	41.20	40.11	41.24
AA	15.32	15.13	14.15	15.05
A	28.01	28.51	29.32	28.78
BBB	14.53	14.51	15.23	14.55
BB	0.59	0.55	1.02	0.35
Not rated	0.45	0.10	0.17	0.05
Maturity Exposure				
0–3 Years	21.43	21.67	19.20	21.80
3–5 Years	23.01	24.17	22.21	24.23
5–10 Years	32.23	31.55	35.21	31.67
10+ Years	23.33	22.61	23.38	22.30
Country Exposure				
United States	42.55	39.44	35.11	39.56
Japan	11.43	18.33	13.33	18.36
France	7.10	6.11	6.01	6.08
United Kingdom	3.44	5.87	4.33	5.99
Germany	6.70	5.23	4.50	5.30
Italy	4.80	4.01	4.43	4.07
Canada	4.44	3.12	5.32	3.15
Other	19.54	17.89	26.97	17.49

Notes: Quality, Maturity Exposure, and Country Exposure are shown as a percentage of the total for each fund and the index. Weights do not always sum to 100 because of rounding.
Source: Barclays Research.

Solution:

Fund X most likely uses an enhanced indexing approach. Fund X's modified duration and convexity are very close to those of the benchmark but still differ slightly. The average maturity of Fund X is slightly longer than that of the benchmark, whereas Fund X's average yield is slightly higher than that of the benchmark. Fund X also has deviations in quality, maturity exposure, and country exposures from the benchmark, providing further evidence of an enhanced indexing approach. Some of these deviations are meaningful; for example, Fund X has a relatively strong underweight in Japan.

Fund Y most likely uses a pure indexing approach because it provides the closest match to the Bloomberg Barclays Global Aggregate Index. The risk and return characteristics are almost identical between Fund Y and the benchmark. Furthermore, quality, maturity exposure, and country exposure deviations from the benchmark are very minor.

Fund Z most likely uses an active management approach because risk and return characteristics, quality, maturity exposure, and country exposure differ markedly from the index. The difference can be seen most notably with the mismatch in modified duration (7.37 for Fund Z versus 6.34 for the benchmark). Other differences exist between Fund Z and the index, but a sizable duration mismatch provides the strongest evidence of an active management approach.

BOND MARKET LIQUIDITY

4

A liquid security is one that may be transacted quickly with little effect on the security's price. Fixed-income securities vary greatly in their liquidity. Recently issued "on-the-run" sovereign government bonds may be very liquid and trade frequently at narrow bid–ask spreads. Other bonds, such as corporate and non-sovereign government bonds, may be very illiquid. These bonds may trade infrequently, in small quantities, or possibly never; and bid–ask spreads, if they are available, may be very wide.

Compared with equities, fixed-income markets are generally less liquid. The global fixed-income universe contains a multitude of individual bonds with varying features. Many issuers have multiple bonds outstanding with their own unique maturity dates, coupon rates, early redemption features, and other specific features. In other words, even for a single issuer, bonds are very heterogeneous. In contrast, each share of a single issuing company's common stock has identical features. Investors must understand the implications of varying features on bond values.

An important structural feature affecting liquidity is that fixed-income markets are typically over-the-counter dealer markets. Search costs (the costs of finding a willing counterparty) exist in bond markets because investors may have to locate desired bonds. In addition, when either buying or selling, investors may have to obtain quotes from various dealers to obtain the most advantageous pricing. With limited, although improving, sources for transaction prices and quotes, bond markets are ordinarily less transparent than equity markets. Liquidity, search costs, and price transparency are closely related to the type of issuer and its credit quality. An investor is likely to find that bonds of a highly creditworthy government issuer are more liquid, have greater price transparency, and have lower search costs than bonds of, for example, a corporate issuer with a lower credit quality.

Bond liquidity is typically highest right after issuance. For example, an on-the-run bond issue of a highly creditworthy sovereign entity is typically more liquid than a bond with similar features—including maturity—that was issued previously (an off-the-run bond). This difference in liquidity is typically found even if the off-the-run

bond was issued only one or two months earlier. One reason for this phenomenon is that soon after bonds are issued, dealers normally have a supply of the bonds in inventory, but as time goes by and bonds are traded, many are purchased by buy-and-hold investors. Once in the possession of such investors, those bonds are no longer available for trading. Typically, after issuance, the available supply of bonds in an issue is reduced and liquidity is impaired.

Liquidity typically affects bond yields. Bond investors require higher yields for investing in illiquid securities relative to otherwise identical securities that are more liquid. The higher yield compensates investors for the costs they may encounter if they try to sell illiquid bonds prior to maturity. These costs include the opportunity costs associated with the delays in finding trading counterparties, as well as the bid–ask spread (which is a direct loss of wealth). The incremental yield investors require for holding illiquid bonds instead of liquid bonds is referred to as a liquidity premium. The magnitude of the liquidity premium normally varies depending on such factors as the issuer, the issue size, and date of maturity. For example, the off-the-run 10-year US Treasury bond typically trades at several basis points higher yield than the on-the-run bond.

4.1 Liquidity among Bond Market Sub-Sectors

Bond market liquidity varies across sub-sectors. These sub-sectors can be categorized by key features such as issuer type, credit quality, issue size, and maturity. The global bond market includes sovereign government bonds, non-sovereign government bonds, government-related bonds, corporate bonds, and securitized bonds (such as asset-backed securities and commercial mortgage-backed securities). For simplicity, in this section we focus on sovereign government and corporate bonds.

Sovereign government bonds are typically more liquid than corporate and non-sovereign government bonds. Their superior liquidity relates to their large issuance size, use as benchmark bonds, acceptance as collateral in the repo market, and well-recognized issuers. Sovereign government bonds of countries with high credit quality are typically more liquid than bonds of lower-credit-quality countries.

In contrast to sovereign government bonds, corporate bonds are issued by many different companies and represent a wide spectrum of credit quality. For corporate bonds with low credit quality, it can be difficult to find a counterparty dealer with the securities in inventory or willing to take them into inventory. Bonds of infrequent issuers are often less liquid than the bonds of issuers with many outstanding issues because market participants are less familiar with companies that seldom issue debt.

Liquidity among sub-sectors can vary across additional dimensions, such as issue size and maturity. For example, in the corporate bond market, smaller issues are generally less liquid than larger issues because small bond issues are typically excluded from major bond indexes with minimum issue size requirements. Further, market participants generally have less incentive to dedicate resources to monitoring smaller issuers, whose bonds may constitute a small proportion of an investor's portfolio. Bonds with longer maturities tend to be less liquid than nearer-term bonds because investors frequently purchase bonds with the intention to hold them until maturity, so such bonds may be unavailable for trading for a long period.

4.2 The Effects of Liquidity on Fixed-Income Portfolio Management

Liquidity concerns influence fixed-income portfolio management in multiple ways, including pricing, portfolio construction, and consideration of alternatives to bonds (such as derivatives).

4.2.1 *Pricing*

As mentioned earlier, pricing in bond markets is generally less transparent than pricing in equity markets. Sources for recent bond transactions—notably corporate bonds—are not always readily available. It should be noted that price transparency is improving in some bond markets. For example, in the United States, the Financial Industry Regulatory Authority's (FINRA) Trade Reporting and Compliance Engine (TRACE) and the Municipal Securities Rulemaking Board's Electronic Municipal Market Access (EMMA) are electronic systems that help to increase transparency in US corporate and municipal bond markets. Outside the United States, corporate bonds traded on market exchanges serve a similar role as TRACE in increasing pricing transparency. In most bond markets, however, the lack of transparency in corporate bond trading presents a challenge.

Because many bonds do not trade, or trade infrequently, using recent transaction prices to represent current value is not practical. Reliance on last traded prices, which may be out-of-date prices that do not incorporate current market conditions, could result in costly trading decisions. The determinants of corporate bond value, including interest rates, credit spreads, and liquidity premiums, change frequently.

For bonds that trade infrequently, a common investor approach is matrix pricing. Matrix pricing uses the recent transaction prices of comparable bonds to estimate the market discount rate or required rate of return on less frequently traded bonds. The comparable bonds have similar features such as credit quality, time to maturity, and coupon rate to the illiquid bond. A benefit of matrix pricing is that it does not require sophisticated financial modeling of bond market characteristics such as term structure and credit spreads. A disadvantage is that some value-relevant features between different bonds (for example, call features) may be ignored.

4.2.2 *Portfolio Construction*

Investors' liquidity needs directly influence portfolio construction. In constructing a portfolio, investors must consider an important trade-off between yield and liquidity. As mentioned previously, illiquid bonds typically have higher yields; a buy-and-hold investor that seeks yield will likely prefer less liquid bonds for these higher yields. By contrast, investors that emphasize liquidity will likely give up some yield and choose more-liquid bonds. Some investors may restrict their portfolio holdings to bonds within a certain maturity range. This restriction reduces the need to sell bonds to generate needed cash inflows. In such cases, the investors that anticipate their liquidity needs may give up the higher yield typically available to longer-term bonds. In addition to avoiding longer-term bonds, investors that have liquidity concerns may also avoid bonds with generally lower liquidity, such as small issues and private placements of corporate bonds.

A challenge in bond portfolio construction relates to the dealer market. Bond dealers often carry an inventory of bonds because buy and sell orders do not arrive simultaneously. A dealer is not certain how long bonds will remain in its inventory. Less liquid bonds are likely to remain in inventory longer than liquid bonds. A dealer provides bid–ask quotes (prices at which it will buy and sell) on bonds of its choice. Some illiquid bonds will not have quotes, particularly bid quotes, from any dealer. A number of different factors determine the bid–ask spread. Riskier bonds often have higher bid–ask spreads because of dealers' aversion to hold those bonds in inventory. Because bond dealers must finance their inventories, the dealers incur costs in both obtaining funding and holding those bonds. Dealers seek to cover their costs and make a profit through the bid–ask spread, and therefore the spread will be higher on illiquid bonds that are likely to remain in inventory longer.

A bond's bid–ask spread is also a function of the bond's complexity and how easily market participants can analyze the issuer's creditworthiness. Bid–ask spreads in government bonds are generally lower than spreads in corporate bonds or structured financial instruments, such as asset-backed securities. Conventional (plain vanilla) corporate bonds normally have lower spreads than corporate bonds with non-standard or complex features, such as embedded options. Bonds of large, high-credit-quality corporations that have many outstanding bond issues are the most liquid among corporate bonds, and thus they have relatively low bid–ask spreads compared with smaller, less creditworthy companies.

Illiquidity directly increases bid–ask spreads on bonds, which increases the cost of trading. Higher transaction costs reduce the benefits to active portfolio decisions and may decrease portfolio managers' willingness to adjust their portfolios to take advantage of opportunities that present themselves.

4.2.3 *Alternatives to Direct Investment in Bonds*

As we have discussed, transacting in fixed-income securities may present challenges because of low liquidity in many global bond markets. As an alternative, investors can use fixed-income derivatives, which are often more liquid than their underlying bonds. Such fixed-income derivatives include those traded on an exchange (for example, futures and options on futures) and those traded over the counter (for example, interest rate swaps and credit default swaps). In particular, bond futures, which are exchange traded and standardized, provide a liquid alternative for investors to gain exposure to the underlying bond(s).

Based on notional amount outstanding, interest rate swaps are the most widely used over-the-counter derivative worldwide. Some interest rate swaps are liquid, with multiple swaps dealers posting competitive two-way quotes. In addition to interest rate swaps, fixed-income portfolio managers use inflation swaps, total return swaps, and credit swaps to alter their portfolio exposure. Because they trade over the counter, swaps may be tailored to an investor's specific needs.

Fixed-income exchange-traded funds (ETFs) and pooled investment vehicles (such as mutual funds) have emerged as another alternative to transacting in individual bonds. ETF shares tend to be more liquid than the underlying individual securities and have thus provided new opportunities for investors seeking liquid fixed-income investments. ETFs may allow certain qualified financial institutions (authorized participants) to transact through in-kind deposits and redemptions (delivering and receiving a portfolio of securities, such as a portfolio of bonds). In the more illiquid bond market sectors, such as high-yield corporate bonds, fixed-income portfolio managers may purchase ETF shares and then redeem those shares for the actual underlying portfolio of bonds. In this redemption process, an ETF authorized participant generally acts as the intermediary between the portfolio managers redeeming their ETF shares and the ETF sponsor supplying the portfolio of bonds.

5 A MODEL FOR FIXED-INCOME RETURNS

Investors often have views on future changes in the yield curve and (re)structure their portfolios accordingly. Investment strategies should be evaluated in terms of expected returns rather than just yields. A bond position's yield provides an incomplete measure of its expected return. Instead, expected fixed-income returns consist of a number of different components in addition to yield. Examining these components leads to a

better understanding of the driving forces behind expected returns. The focus is on *expected* as opposed to *realized* returns, but realized returns can be decomposed in a similar manner.

5.1 Decomposing Expected Returns[4]

Decomposing expected fixed-income returns allows an investor to differentiate among several important return components. At the most general level, expected returns (denoted as E(R) below) can be decomposed (approximately) in the following manner:

$$\begin{aligned} E(R) \approx\ & \text{Yield income} \\ & + \text{ Rolldown return} \\ & + E(\text{Change in price based on investor's views of yields and yield spreads}) \\ & - E(\text{Credit losses}) \\ & + E(\text{Currency gains or losses}) \end{aligned}$$

where E(…) represents effects on expected returns based on expectations of the bracketed item. The decomposition holds only approximately and can be a better or worse approximation of reality depending on the type of bond. It has very general applicability for all types of fixed-income securities, however, ranging from high-credit-quality, home currency sovereign government bonds to lower-credit-quality (high-yield) corporate bonds denominated in a currency other than an investor's home currency. The decomposition should help investors better understand their own investment positions and any assumptions reflected in those positions. The following discussion assumes the model is being applied to an annual period, but the same model can be generalized to other periods. In addition, for simplification, the model does not reflect taxes.

Yield income is the income that an investor receives from coupon payments relative to the bond's price as well as interest on reinvestment income. Assuming there is no reinvestment income, yield income equals a bond's annual current yield.

$$\text{Yield income (or Current yield)} = \text{Annual coupon payment/Current bond price}$$

The rolldown return results from the bond "rolling down" the yield curve as the time to maturity decreases, assuming zero interest rate volatility. Bond prices change as time passes even if the market discount rate remains the same. As time passes, a bond's price typically moves closer to par. This price movement is illustrated by the constant-yield price trajectory, which shows the "pull to par" effect on the price of a bond trading at a premium or a discount to par value. If the issuer does not default, the price of a bond approaches par value as its time to maturity approaches zero.

The rolldown return equals the bond's percentage price change assuming an unchanged yield curve over the strategy horizon. Bonds trading at a premium to their par value will experience capital losses during their remaining life, and bonds trading at a discount relative to their par value will experience capital gains during their remaining life.

To compute the rolldown return, the bond has to be revalued at the end of the strategy horizon assuming an unchanged yield curve. Then the annualized rolldown return is as follows:

$$\text{Rolldown Return} = \frac{\left(\text{Bond price}_{\text{End-of-horizon period}} - \text{Bond price}_{\text{Beginning-of-horizon period}}\right)}{\text{Bond price}_{\text{Beginning-of-horizon period}}}$$

4 Some of this material has been adapted from Hanke and Seals (2010). A more detailed analysis of expected returns of US government bonds can be found in Ilmanen (1995a, 1995b, and 2011).

The sum of the yield income and the rolldown return may be referred to as the bond's rolling yield.

The expected change in price based on investor's views of yields and yield spreads reflects an investor's expectation of changes in yields and yield spreads over the investment horizon. This expected change is zero if the investor expects yield curves and yield spreads to remain unchanged. Assuming the investor does expect a change in the yield curve, this expected return component is computed as follows:

$$\text{E(Change in price based on investor's views of yields and yield spreads)} = [-\text{MD} \times \Delta\text{Yield}] + [\tfrac{1}{2} \times \text{Convexity} \times (\Delta\text{Yield})^2]$$

where MD is the modified duration of a bond, ΔYield is the expected change in yield based on expected changes to both the yield curve and yield spread, and convexity estimates the effect of the non-linearity of the yield curve.[5] It should be noted that for bonds with embedded options, the duration and convexity measures used in the expected return decomposition need to be effective duration and effective convexity. Also, in contrast to fixed-coupon bonds, floating-rate notes have modified duration near zero.

Expected credit losses represent the expected percentage of par value lost to default for a bond. The expected credit loss equals the bond's probability of default (also called expected default rate) multiplied by its expected loss severity (also known as loss given default). Expected credit losses may be low based on past experience of default rates and resulting credit losses. For example, US investment-grade bonds experienced an average annual default rate of around 0.1% from 1980 to 2015.[6]

If an investor holds bonds denominated in a currency other than her home currency, she also needs to factor in any expected fluctuations in the currency exchange rate or expected currency gains or losses over the investment horizon. This quantity could simply be a reflection of her own views, or it could be based on survey information or some kind of quantitative model. It could also be based on the exchange rate that can be locked in over the investment horizon using currency forwards.

The following discussion shows an application of the fixed-income model described here. Expected return and its components are on an annualized basis, and any potential coupons are assumed to be paid annually.

EXAMPLE 5

Decomposing Expected Returns

Ann Smith works for a US investment firm in its London office. She manages the firm's British pound–denominated corporate bond portfolio. Her department head in New York has asked Smith to make a presentation on the next year's total expected return of her portfolio in US dollars and the components of this return. Exhibit 7 shows information on the portfolio and Smith's expectations for the next year. Calculate the total expected return of Smith's bond portfolio, assuming no reinvestment income.

5 Leibowitz, Krasker, and Nozari (1990) offer a detailed analysis of spread duration.

6 As reported by Vazza and Kraemer (2016), for the period 1981 to 2015, the average one-year cumulative global corporate default rates were 0.10% for investment-grade issues, 3.80% for speculative-grade (high-yield) issues, and 1.49% for all rated issues. Yearly default rates vary, however, and during the period 1981 to 2015, one-year cumulative global corporate default rates ranged between 0.14% (1981) and 4.18% (2009) for all rated issues.

Exhibit 7 Portfolio Characteristics and Expectations

Notional principal of portfolio (in millions)	£100
Average bond coupon payment (per £100)	£2.75
Coupon frequency	Annual
Investment horizon	1 year
Current average bond price	£97.11
Expected average bond price in one year (assuming an unchanged yield curve)	£97.27
Average bond convexity	18
Average bond modified duration	3.70
Expected average yield and yield spread change	0.26%
Expected credit losses	0.10%
Expected currency losses (£ depreciation versus US$)	0.50%

Solution:

The portfolio's yield income is 2.83%. The portfolio has an average coupon of £2.75 on a £100 notional principal and currently trades at £97.11. The yield income over a one-year horizon is 2.83% = £2.75/£97.11.

In one year's time, assuming an unchanged yield curve and zero interest rate volatility, the rolldown return is 0.16% = (£97.27 – £97.11)/£97.11.

The rolling yield, which is the sum of the yield income and the rolldown return, is 2.99% = 2.83% + 0.16%.

The expected change in price based on Smith's views of yields and yield spreads is –0.96%. The bond portfolio has a modified duration of 3.70 and a convexity statistic of 0.18. Smith expects an average yield and yield spread change of 0.26%. Smith expects to incur a decrease in prices and a reduction in return based on her yield view. The expected change in price based on Smith's views of yields and yield spreads is thus $-0.0096 = [-3.70 \times 0.0026] + [\frac{1}{2} \times 18 \times (0.0026)^2]$. So the expected reduction in return based on Smith's yield view is 0.96%.

Smith expects 0.1% of credit losses in her well-diversified investment-grade bond portfolio.

Smith expects the British pound, the foreign currency in which her bond position is denominated, to depreciate by an annualized 50 bps (or 0.5%) over the investment horizon against the US dollar, the home country currency. The expected currency loss to the portfolio is thus 0.50%.

After combining the foregoing return components, the total expected return on Smith's bond position is 1.43%. For ease of reference, Exhibit 8 summarizes the calculations.

Exhibit 8 Return Component Calculations

Return Component	Formula	Calculation
Yield income	Annual coupon payment/Current bond price	£2.75/£97.11 = 2.83%
+ Rolldown return	$\frac{\left(\text{Bond price}_{\text{End-of-horizon period}} - \text{Bond price}_{\text{Beginning-of-horizon period}}\right)}{\text{Bond price}_{\text{Beginning-of-horizon period}}}$	(£97.27 – £97.11)/£97.11 = 0.16%
= Rolling yield	Yield income + Rolldown return	2.83% + 0.16% = 2.99%

(continued)

Exhibit 8 (Continued)

Return Component	Formula	Calculation
+ E(Change in price based on Smith's yield and yield spread view)	[−MD × ΔYield] + [½ × Convexity × (ΔYield)^2]	[−3.70 × 0.0026] + [½ × 18 × (0.0026)^2] = −0.96%
− E(Credit losses)	given	−0.10%
+ E(Currency gains or losses)	given	−0.50%
= **Total expected return**		**1.43%**

5.2 Estimation of the Inputs

In the model for fixed-income returns discussed earlier, some of the individual expected return components can be more easily estimated than others. The easiest component to estimate is the yield income. The rolldown return, although still relatively straightforward to estimate, depends on the curve-fitting technique used.

The return model's most uncertain individual components are the investor's views of changes in yields and yield spreads, expected credit losses, and expected currency movements. These components are normally based on purely qualitative (subjective) criteria, on survey information, or on a quantitative model. Although a quantitative approach may seem more objective, the choice of quantitative model is largely subjective given the multitude of such models available.

5.3 Limitations of the Expected Return Decomposition

The return decomposition described in Section 5.1 is an approximation; only duration and convexity are used to summarize the price–yield relationship. In addition, the model implicitly assumes that all intermediate cash flows of the bond are reinvested at the yield to maturity, which results in different coupon reinvestment rates for different bonds.

The model also ignores other factors, such as local richness/cheapness effects as well as potential financing advantages. Local richness/cheapness effects are deviations of individual maturity segments from the fitted yield curve, which was obtained using a curve estimation technique. Yield curve estimation techniques produce relatively smooth curves, and there are likely slight deviations from the curve in practice. There may be financing advantages to certain maturity segments in the repo market. The repo market provides a form of short-term borrowing for dealers in government securities who sell government bonds to other market participants overnight and buy them back, typically on the following day. In most cases, local richness/cheapness effects and financing advantages tend to be relatively small and are thus not included in the expected return decomposition model.

EXAMPLE 6

Components of Expected Return

Kevin Tucker manages a global bond portfolio. At a recent investment committee meeting, Tucker discussed his portfolio's domestic (very high credit quality) government bond allocation with another committee member. The

other committee member argued that if the yield curve is expected to remain unchanged, the only determinants of a domestic government bond's expected return are its coupon payment and its price.

Explain why the other committee member is incorrect, including a description of the additional expected return components that need to be included.

Solution:

A bond's coupon payment and its price allow only its yield income to be computed. Yield income is an incomplete measure of a bond's expected return. For domestic government bonds, in addition to yield income, the rolldown return needs to be considered. The rolldown return results from the fact that bonds are pulled to par as the time to maturity decreases, even if the yield curve is expected to remain unchanged over the investment horizon. Currency gains and losses would also need to be considered in a global portfolio. Because the portfolio consists of government bonds with very high credit quality, the view on credit spreads and expected credit losses are less relevant for Tucker's analysis. For government and corporate bonds with lower credit quality, however, credit spreads and credit losses would also need to be considered as additional return components.

LEVERAGE

6

Leverage is the use of borrowed capital to increase the magnitude of portfolio positions, and it is an important tool for fixed-income portfolio managers. By using leverage, fixed-income portfolio managers may be able to increase portfolio returns relative to what they can achieve in unleveraged portfolios.

Managers often have mandates that place limits on the types of securities they may hold. Simultaneously, managers may have return objectives that are difficult to achieve, especially during low interest rate environments. Through the use of leverage, a manager can increase his investment exposure and may be able to increase the returns to fixed-income asset classes that typically have low returns. The increased return potential, however, comes at the cost of increased risk: If losses occur, these would be higher than in unleveraged positions.

6.1 Using Leverage

Leverage increases portfolio returns if the securities in the portfolio have higher returns than the cost of borrowing. In an unleveraged portfolio, the return on the portfolio (r_p) equals the return on invested funds (r_I). When the manager uses leverage, however, the invested funds exceed the portfolio's equity by the amount that is borrowed.

The leveraged portfolio return, r_p, can be expressed as the total investment gains per unit of invested capital:

$$r_P = \frac{\text{Portfolio return}}{\text{Portfolio equity}} = \frac{\left[r_I \times \left(V_E + V_B\right) - \left(V_B \times r_B\right)\right]}{V_E}$$

where

V_E = value of the portfolio's equity
V_B = borrowed funds
r_B = borrowing rate (cost of borrowing)
r_I = return on the invested funds (investment returns)
r_p = return on the levered portfolio

The numerator represents the total return on the portfolio assets, $r_I \times (V_E + V_B)$, minus the cost of borrowing, $V_B \times r_B$, divided by the portfolio's equity.

The leveraged portfolio return can be decomposed further to better identify the effect of leverage on returns:

$$\begin{aligned} r_P &= \frac{\left[r_I \times (V_E + V_B) - (V_B \times r_B)\right]}{V_E} \\ &= \frac{(r_I \times V_E) + \left[V_B \times (r_I - r_B)\right]}{V_E} \\ &= r_I + \frac{V_B}{V_E}(r_I - r_B) \end{aligned}$$

This expression decomposes the leveraged portfolio return into the return on invested funds and a portion that accounts for the effect of leverage. If $r_I > r_B$, then the second term is positive because the rate of return on invested funds exceeds the borrowing rate—in this case, leverage increases the portfolio's return. If $r_I < r_B$, then the second term is negative because the rate of return on invested funds is less than the borrowing rate—in this case, the use of leverage decreases the portfolio's return. The degree to which the leverage increases or decreases portfolio returns is proportional to the use of leverage (amount borrowed), V_B/V_E, and the amount by which investment return differs from the cost of borrowing, $(r_I - r_B)$.

6.2 Methods for Leveraging Fixed-Income Portfolios

Fixed-income portfolio managers have a variety of tools available to create leveraged portfolio exposures, notably the use of financial derivatives as well as borrowing via collateralized money markets. Derivatives or borrowing are explicit forms of leverage. Other forms of leverage, such as the use of structured financial instruments, are more implicit.

6.2.1 *Futures Contracts*

Futures contracts embed significant leverage because they permit the counterparties to gain exposure to a large quantity of the underlying asset without having to actually transact in the underlying. Futures contracts can be obtained for a modest investment that comes in the form of a margin deposit. A futures contract's notional value equals the current value of the underlying asset multiplied by the multiplier, or the quantity of the underlying asset controlled by the contract.

The futures leverage is the ratio of the futures exposure (in excess of the margin deposit) normalized by the amount of margin required to control the notional amount. We can calculate the futures leverage using the following equation:

$$\text{Leverage}_{\text{Futures}} = \frac{\text{Notional value} - \text{Margin}}{\text{Margin}}$$

6.2.2 *Swap Agreements*

Interest rate swaps can be viewed as a portfolio of bonds. In an interest rate swap, the fixed-rate payer is effectively short a fixed-rate bond and long a floating-rate bond. When interest rates increase, the value of the swap to the fixed-rate payer increases because the present value of the fixed-rate liability decreases and the floating-rate payments received increase. The fixed-rate receiver in the interest rate swap agreement effectively has a long position in a fixed-rate bond and a short position in a floating-rate bond. If interest rates decline, the value of the swap to the fixed-rate receiver increases because the present value of the fixed-rate asset increases and the floating-rate payments made decrease.

Because interest rate swaps are economically equivalent to a long–short bond portfolio, they provide leveraged exposure to bonds; the only capital required to enter into swap agreements is collateral required by the counterparties. Collateral for interest rate swap agreements has historically occurred between the two (or more) counterparties in the transaction. Increasingly, collateral for interest rate and other swaps occurs through central clearinghouses. The most significant driver of this shift has been regulation enacted after the 2008–2009 global financial crisis. Clearing of interest rate swaps through central clearinghouses has increased standardization and has reduced counterparty risk.

6.2.3 *Structured Financial Instruments*

Structured financial instruments (or structured products) are designed to repackage and redistribute risks. Many structured financial instruments have embedded leverage. An example of such a structured financial instrument is an inverse floating-rate note, also known as an inverse floater. An inverse floater's defining feature is that its coupon has an inverse relationship to a market interest rate such as Libor. As an example, the coupon rate for an inverse floater may be as follows:

$$\text{Coupon rate} = 15\% - (1.5 \times \text{Libor}_{\text{3-month}})$$

The inverse floater exacerbates the magnitude of the inverse relationship between bond prices and interest rates. The coupon rate in the example above can range from 0% to 15%. If three-month Libor increases to at least 10%, the coupon rate is 0%. At the other extreme, if three-month Libor decreases to 0%, the coupon rate is 15%. It should be noted that the inverse floater's structure would specify that the coupon rate cannot be less than 0%. A long position in an inverse floater is ideal for a fixed-income manager looking to express a strong view that interest rates will remain low or possibly decline over the life of the bond. However, the embedded leverage adds an additional source of price volatility to a fixed-income investor's portfolio.

6.2.4 *Repurchase Agreements*

Repurchase agreements (repos) are an important source of short-term financing for fixed-income securities dealers and other financial institutions, as evidenced by the trillions of dollars of repo transactions that take place annually. In a repurchase agreement, a security owner agrees to sell a security for a specific cash amount while simultaneously agreeing to repurchase the security at a specified future date (typically one day later) and price. Repos are thus effectively collateralized loans. When referring to a repo, the transaction normally refers to the borrower's standpoint; from the standpoint of the lender, these agreements are referred to as **reverse repos**.

The interest rate on a repurchase agreement, called the **repo rate**, is the difference between the security's selling price and its repurchase price. For example, consider a dealer wishing to finance a $15 million bond position with a repurchase agreement.

The dealer enters into an overnight repo at a repo rate of 5%. We can compute the price at which she agrees to repurchase this bond after one day as the $15 million value today plus one day of interest. The interest amount is computed as follows:

Dollar interest = Principal amount × Repo rate × (Term of repo in days/360)

Continuing with the example, the dollar interest = $2,083.33 = $15 million × 5% × (1/360). Thus, the dealer will repurchase the bond the next day for $15,002,083.33.

The term, or length, of a repurchase agreement is measured in days. Overnight repos are common, although they are often rolled over to create longer-term funding. A repo agreement may be cash driven or security driven. Cash-driven transactions feature one party that owns bonds and wants to borrow cash, as in the foregoing example. Cash-driven transactions usually feature "general collateral," which are securities commonly accepted by investors and dealers, such as Treasury bonds. In a security-driven transaction, the lender typically seeks a particular security. The motives may be for hedging, arbitrage, or speculation.

Credit risk is a concern in a repo agreement, in particular for the counterparty that lends capital. Protection against a default by the borrower is provided by the underlying collateral bonds. Additional credit protection comes from the "haircut," the amount by which the collateral's value exceeds the repo principal amount. For example, haircuts for high-quality government bonds typically range from 1% to 3% and are higher for other types of bonds. The size of the haircut serves to not only protect the lender against a potential default by the borrower but also to limit the borrower's net leverage capacity. Generally, the size of the haircut increases as the price volatility of the underlying collateral increases.

Repos are categorized as bilateral repos or tri-party repos based on the way they are settled. Bilateral repos are conducted directly between two institutions, and settlement is typically conducted as "delivery versus payment," meaning that the exchanges of cash and collateral occur simultaneously through a central custodian (for example, the Depository Trust Company in the United States). Bilateral repos are usually used for security-driven transactions. Tri-party repo transactions involve a third party that provides settlement and collateral management services. Most cash-motivated repo transactions against general collateral are conducted as tri-party repo transactions.

6.2.5 *Securities Lending*

Securities lending is another form of collateralized lending, and is closely linked to the repo market. The primary motive of securities lending transactions is to facilitate short sales, which involve the sale of securities the seller does not own. A short seller must borrow the securities he has sold short in order to deliver them upon trade settlement. Another motive for securities lending transactions is financing, or collateralized borrowing. In a financing-motivated security loan, a bond owner lends the bond to another investor in exchange for cash.

Security lending transactions are collateralized by cash or high-credit-quality bonds. In the United States, most transactions feature cash collateral, although in many other countries, highly rated bonds are used as collateral. Typically, security lenders require collateral valued in excess of the value of the borrowed securities when bonds are used as collateral. For example, if high-quality government bonds are used as collateral, the lender may require bonds valued at 102% of the value of the borrowed securities. The extra 2% functions in the same way as the haircut in the repo market, providing extra protection against borrower default. The collateral required will increase if lower-quality bonds are used as collateral.

In security lending transactions with cash collateral, the security borrower typically pays the security lender a fee equal to a percentage of the value of the securities loaned. For securities that are readily available for lending, that fee is small. The security lender earns an additional return by reinvesting the cash collateral. In cases

where the securities loan is initiated for financing purposes, the lending fee is typically negative, indicating that the security lender pays the security borrower a fee in exchange for its use of the cash.

When bonds are posted as collateral, the income earned on the collateral usually exceeds the security lending rate; the security lender (who is in possession of the bonds as collateral) usually repays the security borrower a portion of the interest earned on the bond collateral. The term **rebate rate** refers to the portion of the collateral earnings rate that is repaid to the security borrower by the security lender. This relationship can be expressed as follows:

Rebate rate = Collateral earnings rate − Security lending rate

When securities are difficult to borrow, the rebate rate may be negative, which means the fee for borrowing the securities is greater than the return earned on the collateral. In this case, the security borrower pays a fee to the security lender in addition to forgoing the interest earned on the collateral.

There are important differences between repurchase agreements and securities lending transactions. Unlike repurchase agreements, security lending transactions are typically open-ended. The securities lender may recall the securities at any time, forcing the borrower to deliver the bonds by buying them back or borrowing from another lender. Similarly, the borrower may deliver the borrowed securities back to the lender at any time, forcing the lender, or its agent, to return the collateral (cash or bonds) and search for another borrower.

6.3 Risks of Leverage

Leverage alters the risk–return properties of an investment portfolio. A heavily leveraged portfolio may incur significant losses even when portfolio assets suffer only moderate valuation declines.

Leverage can lead to forced liquidations. If the value of the portfolio decreases, the portfolio's equity relative to borrowing levels is reduced and the portfolio's leverage increases. Portfolio assets may be sold in order to pay off borrowing and reduce leverage. If portfolio assets are not liquidated, then the overall leverage increases, corresponding to higher levels of risk. Decreases in portfolio value can lead to forced liquidations even if market conditions are unfavorable for selling—for example, during crisis periods. The term "fire sale" refers to forced liquidations at prices that are below fair value as a result of the seller's need for immediate liquidation. Reducing leverage, declining asset values, and forced sales have the potential to create spiraling effects that can result in severe declines in values and reduction in market liquidity.

Additionally, reassessments of counterparty risk typically occur during extreme market conditions, such as occurred in the 2008–2009 financial crisis. During periods of financial crisis, counterparties to short-term financing arrangements, such as credit lines, repurchase agreements, and securities lending agreements, may withdraw their financing. These withdrawals undermine the ability of leveraged market participants to maintain their investment exposures. Thus, the leveraged investor may be forced to reduce their investment exposure at exactly the worst time—that is, when prices are depressed.

7 FIXED-INCOME PORTFOLIO TAXATION

A tax-exempt investor's objective is to achieve the highest possible risk-adjusted returns net of fees and transaction costs. A taxable investor needs to also consider the effects of taxes on both expected and realized net investment returns. Taxes typically complicate investment decisions.

The investment management industry has traditionally made investment decisions based on pretax returns as though investors are tax exempt (such as pension funds in many countries).[7] The majority of the world's investable assets, however, is owned by taxable investors, who are concerned with after-tax rather than pretax returns.

Taxes may differ across investor types, among countries, and based on income source, such as interest or capital gains. In many countries, pension funds are exempt from taxes but corporations generally have to pay tax on their investments. Many countries make some allowance for tax-sheltered investments that individuals can use (up to certain limits). These types of tax shelters generally offer either an exemption from tax on investment income or a deferral of taxes until an investor draws money from the shelter (usually after retirement). Such shelters allow returns to accrue on a pretax basis until retirement, which can provide substantial benefits. In a fixed-income context for taxable investors, coupon payments (interest income) are typically taxed at the investor's normal income tax rate. Capital gains, however, may be taxed at a lower effective rate than an investor's normal income tax rate. In some countries, income from special types of fixed-income securities, such as bonds issued by the sovereign government, a non-sovereign government, or various government agencies, may be taxed at a lower effective rate or even not taxed.

It is beyond the scope of this reading to discuss specific tax rules because these vary across countries. Any discussion of the effect of taxes on investor returns—and therefore on how portfolios should optimally be managed for taxable investors—is especially challenging if it needs to apply on a global level. Although accounting standards have become more harmonized globally, any kind of tax harmonization among countries is not likely to occur anytime soon. An investor should consider how taxes affect investment income in the country where the income is earned and how the investment income is treated when it is repatriated to the investor's home country. Treaties between countries may affect tax treatment of investment income. Taxes are complicated and can make investment decisions difficult. Portfolio managers who manage assets for taxable individual investors, as opposed to tax-exempt investors, need to consider a number of issues.

7.1 Principles of Fixed-Income Taxation

Although tax codes differ across countries, there are certain principles that most tax codes have in common with regard to taxation of fixed-income investments:

- The two primary sources of investment income that affect taxes for fixed-income securities are coupon payments (interest income) and capital gains or losses.
- In general, tax is payable only on capital gains and interest income that have actually been received. In some countries, an exception to this rule applies to zero-coupon bonds. Imputed interest may be calculated that is taxed

7 See, for example, Rogers (2006).

throughout a zero-coupon bond's life. This method of taxation ensures that tax is paid over the bond's life and that the return on a zero-coupon bond is not taxed entirely as a capital gain.

- Capital gains are frequently taxed at a lower effective tax rate than interest income.
- Capital losses generally cannot be used to reduce sources of income other than capital gains. Capital losses reduce capital gains in the tax year in which they occur. If capital losses exceed capital gains in the year, they can often be "carried forward" and applied to gains in future years; in some countries, losses may also be "carried back" to reduce capital gains taxes paid in prior years. Limits typically exist on the number of years that capital losses can be carried forward or back.
- In some countries, short-term capital gains are taxed at a different (usually higher) rate than long-term capital gains.

An investor or portfolio manager generally has no control over the timing of when coupon income is received and the related income tax must be paid. However, he or she can generally decide the timing of sale of investments and therefore has some control over the timing of realized capital gains and losses. This control can be valuable for a taxable investor because it may be optimal to delay realizing gains and related tax payments and to realize losses as early as possible. This type of tax-driven strategic behavior is referred to as tax-loss harvesting.

Key points for managing taxable fixed-income portfolios include the following:

- Selectively offset capital gains and losses for tax purposes.
- If short-term capital gains tax rates are higher than long-term capital gains tax rates, then be judicious when realizing short term gains.
- Realize losses taking into account tax consequences. They may be used to offset current or future capital gains for tax purposes.
- Control turnover in the fund. In general, the lower the turnover, the longer capital gains tax payments can be deferred.
- Consider the trade-off between capital gains and income for tax purposes.

7.2 Investment Vehicles and Taxes

The choice of investment vehicle often affects how investments are taxed at the final investor level. In a pooled investment vehicle (sometimes referred to as a collective investment scheme) such as a mutual fund, interest income is generally taxed at the final investor level when it occurs—regardless of whether the fund reinvests interest income or pays it out to investors. In other words, for tax purposes the fund is considered to have distributed interest income for tax purposes in the year it is received even if it does not actually pay it out to investors. Taxation of capital gains arising from the individual investments within a fund is often treated differently in different countries.

Some countries, such as the United States, use what is known as *pass-through treatment* of capital gains in mutual funds. Realized net capital gains in the underlying securities of a fund are treated as if distributed to investors in the year that they arise, and investors need to include the gains on their tax returns. Other countries, such as the United Kingdom, do not use pass-through treatment. Realized capital gains arising within a fund increase the net asset value of the fund shares that investors hold. Investors pay taxes on the net capital gain when they sell their fund shares. This tax treatment leads to a deferral in capital gains tax payments. The UK portfolio manager's decisions on when to realize capital gains or losses do not affect the timing of tax payments on capital gains by investors.

In a separately managed account, an investor typically pays tax on realized gains in the underlying securities at the time they occur. The investor holds the securities directly rather than through shares in a fund. For separately managed accounts, the portfolio manager needs to consider tax consequences for the investor when making investment decisions.

Tax-loss harvesting, which we defined earlier as deferring the realization of gains and realizing capital losses early, allows investors to accumulate gains on a pretax basis. The deferral of taxes increases the present value of investments to the investor.

EXAMPLE 7

Managing Taxable and Tax-Exempt Portfolios

A bond portfolio manager needs to raise €10,000,000 in cash to cover outflows in the portfolio she manages. To satisfy her cash demands, she considers one of two corporate bond positions for potential liquidation: Position A and Position B. For tax purposes, capital gains receive pass-through treatment; realized net capital gains in the underlying securities of a fund are treated as if distributed to investors in the year that they arise. Assume that the capital gains tax rate is 28% and the income tax rate for interest is 45%. Exhibit 9 provides relevant data for the two bond positions.

Exhibit 9 Selected Data for Two Bonds

	Position A		Position B
Current market value	€10,000,000		€10,000,000
Capital gain/loss	€1,000,000		–€1,000,000
Coupon rate	5.00%		5.00%
Remaining maturity	10 years		10 years
Income tax rate		45%	
Capital gains tax rate		28%	

The portfolio manager considers Position A to be slightly overvalued and Position B to be slightly undervalued. Assume that the two bond positions are identical with regard to all other relevant characteristics. How should the portfolio manager optimally liquidate bond positions if she manages a portfolio for:

1 tax-exempt investors?
2 taxable investors?

Solution to 1:

The taxation of capital gains and capital losses has minimal consequences to tax-exempt investors. Consistent with the portfolio manager's investment views, the portfolio manager would likely liquidate Position A, which she considers slightly overvalued rather than liquidating Position B, which she considers slightly undervalued.

Solution to 2:

All else equal, portfolio managers for taxable investors should have an incentive to defer capital gains taxes and realize capital losses early (tax-loss harvesting) so that losses can be used to offset current or future capital gains. Despite the

slight undervaluation of the position, the portfolio manager might want to liquidate Position B because of its embedded capital loss, which will result in a lower realized net capital gain being distributed to investors. This decision is based on the assumption that there are no other capital losses in the portfolio that can be used to offset other capital gains. Despite the slight overvaluation of Position A, its liquidation would be less desirable for a taxable investor because of the required capital gains tax.

SUMMARY

This reading describes the roles of fixed-income securities in an investment portfolio and introduces fixed-income portfolio management. Key points of the reading include the following:

- Fixed-income investments provide diversification benefits in a portfolio context. These benefits arise from the generally low correlations of fixed-income investments with other major asset classes such as equities.
- Fixed-income investments have regular cash flows, which is beneficial for the purposes of funding future liabilities.
- Floating-rate and inflation-linked bonds can be used to hedge inflation risk.
- Liability-based fixed-income mandates are managed to match or cover expected liability payments with future projected cash inflows.
- For liability-based fixed-income mandates, portfolio construction follows two main approaches—cash flow matching and duration matching—to match fixed-income assets with future liabilities.
- Cash flow matching is an immunization approach based on matching bond cash flows with liability payments.
- Duration matching is an immunization approach based on matching the duration of assets and liabilities.
- Hybrid forms of duration and cash flow matching include contingent immunization and horizon matching.
- Total return mandates are generally structured to either track or outperform a benchmark.
- Total return mandates can be classified into different approaches based on their target active return and active risk levels. Approaches range from pure indexing to enhanced indexing to active management.
- Liquidity is an important consideration in fixed-income portfolio management. Bonds are generally less liquid than equities, and liquidity varies greatly across sectors.
- Liquidity affects pricing in fixed-income markets because many bonds either do not trade or trade infrequently.
- Liquidity affects portfolio construction because there is a trade-off between liquidity and yield. Less liquid bonds have higher yields, all else being equal, and may be more desirable for buy-and-hold investors. Investors anticipating liquidity needs may forgo higher yields for more-liquid bonds.

- Fixed-income derivatives, as well as fixed-income exchange-traded funds and pooled investment vehicles, are often more liquid than their underlying bonds and provide investment managers with an alternative to trading in illiquid underlying bonds.
- When evaluating fixed-income investment strategies, it is important to consider expected returns and to understand the different components of expected returns.
- Decomposing expected fixed-income returns allows investors to understand the different sources of returns given expected changes in bond market conditions.
- A model for expected fixed-income returns can decompose them into the following components: yield income, rolldown return, expected change in price based on investor's views of yields and yield spreads, expected credit losses, and expected currency gains or losses.
- Leverage is the use of borrowed capital to increase the magnitude of portfolio positions. By using leverage, fixed-income portfolio managers may be able to increase portfolio returns relative to what they can achieve in unleveraged portfolios. The potential for increased returns, however, comes with increased risk.
- Methods for leveraging fixed-income portfolios include the use of futures contracts, swap agreements, structured financial instruments, repurchase agreements, and securities lending.
- Taxes can complicate investment decisions in fixed-income portfolio management. Complications result from the difference in taxation across investor types, countries, and income sources (interest income or capital gains).

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PRACTICE PROBLEMS

The following information relates to Questions 1–6

Cécile Perreaux is a junior analyst for an international wealth management firm. Her supervisor, Margit Daasvand, asks Perreaux to evaluate three fixed-income funds as part of the firm's global fixed-income offerings. Selected financial data for the funds Aschel, Permot, and Rosaiso are presented in Exhibit 1. In Perreaux's initial review, she assumes that there is no reinvestment income and that the yield curve remains unchanged.

Exhibit 1 Selected Data on Fixed-Income Funds

	Aschel	Permot	Rosaiso
Current average bond price	$117.00	$91.50	$94.60
Expected average bond price in one year (end of Year 1)	$114.00	$96.00	$97.00
Average modified duration	7.07	7.38	6.99
Average annual coupon payment	$3.63	$6.07	$6.36
Present value of portfolio's assets (millions)	$136.33	$68.50	$74.38
Bond type*			
Fixed-coupon bonds	95%	38%	62%
Floating-coupon bonds	2%	34%	17%
Inflation-linked bonds	3%	28%	21%
Quality*			
AAA	65%	15%	20%
BBB	35%	65%	50%
B	0%	20%	20%
Not rated	0%	0%	10%
Value of portfolio's equity (millions)	$94.33		
Value of borrowed funds (millions)	$42.00		
Borrowing rate	2.80%		
Return on invested funds	6.20%		

* Bond type and Quality are shown as a percentage of total for each fund.

After further review of the composition of each of the funds, Perreaux notes the following.

Note 1 Aschel is the only fund of the three that uses leverage.

Note 2 Rosaiso is the only fund of the three that holds a significant number of bonds with embedded options.

Daasvand asks Perreaux to analyze immunization approaches to liability-based mandates for a meeting with Villash Foundation. Villash Foundation is a tax-exempt client. Prior to the meeting, Perreaux identifies what she considers to be two key features of a cash flow–matching approach.

Feature 1	It requires no yield curve assumptions.
Feature 2	Cash flows come from coupons and liquidating bond portfolio positions.

Two years later, Daasvand learns that Villash Foundation needs $5,000,000 in cash to meet liabilities. She asks Perreaux to analyze two bonds for possible liquidation. Selected data on the two bonds are presented in Exhibit 2.

Exhibit 2 Selected Data for Bonds 1 and 2

	Bond 1	Bond 2
Current market value	$5,000,000	$5,000,000
Capital gain/loss	400,000	–400,000
Coupon rate	2.05%	2.05%
Remaining maturity	8 years	8 years
Investment view	Overvalued	Undervalued
Income tax rate	39%	
Capital gains tax rate	30%	

1 Based on Exhibit 1, which fund provides the highest level of protection against inflation for coupon payments?

A Aschel

B Permot

C Rosaiso

2 Based on Exhibit 1, the rolling yield of Aschel over a one-year investment horizon is *closest* to:

A –2.56%.

B 0.54%.

C 5.66%.

3 The levered portfolio return for Aschel is *closest* to:

A 7.25%.

B 7.71%.

C 8.96%.

4 Based on Note 2, Rosaiso is the only fund for which the expected change in price based on the investor's views of yields and yield spreads should be calculated using:

A convexity.

B modified duration.

C effective duration

5 Is Perreaux correct with respect to key features of cash flow matching?

A Yes.

B No, only Feature 1 is correct.

C No, only Feature 2 is correct.

6 Based on Exhibit 2, the optimal strategy to meet Villash Foundation's cash needs is the sale of:

A 100% of Bond 1.

B 100% of Bond 2.

C 50% of Bond 1 and 50% of Bond 2.

The following information relates to Questions 7–12

Celia Deveraux is chief investment officer for the Topanga Investors Fund, which invests in equities and fixed income. The clients in the fund are all taxable investors. The fixed-income allocation includes a domestic (US) bond portfolio and an externally managed global bond portfolio.

The domestic bond portfolio has a total return mandate, which specifies a long-term return objective of 25 basis points (bps) over the benchmark index. Relative to the benchmark, small deviations in sector weightings are permitted, such risk factors as duration must closely match, and tracking error is expected to be less than 50 bps per year.

The objectives for the domestic bond portfolio include the ability to fund future liabilities, protect interest income from short-term inflation, and minimize the correlation with the fund's equity portfolio. The correlation between the fund's domestic bond portfolio and equity portfolio is currently 0.14. Deveraux plans to reduce the fund's equity allocation and increase the allocation to the domestic bond portfolio. She reviews two possible investment strategies.

Strategy 1 Purchase AAA rated fixed-coupon corporate bonds with a modified duration of two years and a correlation coefficient with the equity portfolio of –0.15.

Strategy 2 Purchase US government agency floating-coupon bonds with a modified duration of one month and a correlation coefficient with the equity portfolio of –0.10.

Deveraux realizes that the fund's return may decrease if the equity allocation of the fund is reduced. Deveraux decides to liquidate $20 million of US Treasuries that are currently owned and to invest the proceeds in the US corporate bond sector. To fulfill this strategy, Deveraux asks Dan Foster, a newly hired analyst for the fund, to recommend Treasuries to sell and corporate bonds to purchase.

Foster recommends Treasuries from the existing portfolio that he believes are overvalued and will generate capital gains. Deveraux asks Foster why he chose only overvalued bonds with capital gains and did not include any bonds with capital losses. Foster responds with two statements.

Statement 1 Taxable investors should prioritize selling overvalued bonds and always sell them before selling bonds that are viewed as fairly valued or undervalued.

Statement 2 Taxable investors should never intentionally realize capital losses.

Regarding the purchase of corporate bonds, Foster collects relevant data, which are presented in Exhibit 1.

Exhibit 1 Selected Data on Three US Corporate Bonds

Bond Characteristics	Bond 1	Bond 2	Bond 3
Credit quality	AA	AA	A
Issue size ($ millions)	100	75	75
Maturity (years)	5	7	7
Total issuance outstanding ($ millions)	1,000	1,500	1,000
Months since issuance	New issue	3	6

Deveraux and Foster review the total expected 12-month return (assuming no reinvestment income) for the global bond portfolio. Selected financial data are presented in Exhibit 2.

Exhibit 2 Selected Data on Global Bond Portfolio

Notional principal of portfolio (in millions)	€200
Average bond coupon payment (per €100 par value)	€2.25
Coupon frequency	Annual
Current average bond price	€98.45
Expected average bond price in one year (assuming an unchanged yield curve)	€98.62
Average bond convexity	22
Average bond modified duration	5.19
Expected average yield and yield spread change	0.15%
Expected credit losses	0.13%
Expected currency gains (€ appreciation vs. $)	0.65%

Deveraux contemplates adding a new manager to the global bond portfolio. She reviews three proposals and determines that each manager uses the same index as its benchmark but pursues a different total return approach, as presented in Exhibit 3.

Exhibit 3 New Manager Proposals Fixed-Income Portfolio Characteristics

Sector Weights (%)	Manager A	Manager B	Manager C	Index
Government	53.5	52.5	47.8	54.1
Agency/quasi-agency	16.2	16.4	13.4	16.0

Exhibit 3 (Continued)

Sector Weights (%)	Manager A	Manager B	Manager C	Index
Corporate	20.0	22.2	25.1	19.8
MBS	10.3	8.9	13.7	10.1

Risk and Return Characteristics	Manager A	Manager B	Manager C	Index
Average maturity (years)	7.63	7.84	8.55	7.56
Modified duration (years)	5.23	5.25	6.16	5.22
Average yield (%)	1.98	2.08	2.12	1.99
Turnover (%)	207	220	290	205

7 Which approach to its total return mandate is the fund's domestic bond portfolio *most likely* to use?

A Pure indexing

B Enhanced indexing

C Active management

8 Strategy 2 is *most likely* preferred to Strategy 1 for meeting the objective of:

A protecting inflation.

B funding future liabilities.

C minimizing the correlation of the fund's domestic bond portfolio and equity portfolio.

9 Are Foster's statements to Deveraux supporting Foster's choice of bonds to sell correct?

A Only Statement 1 is correct.

B Only Statement 2 is correct.

C Neither Statement 1 nor Statement 2 is correct.

10 Based on Exhibit 1, which bond *most likely* has the highest liquidity premium?

A Bond 1

B Bond 2

C Bond 3

11 Based on Exhibit 2, the total expected return of the fund's global bond portfolio is *closest* to:

A 0.90%.

B 2.20%.

C 3.76%.

12 Based on Exhibit 3, which manager is *most likely* to have an active management total return mandate?

A Manager A

B Manager B

C Manager C

SOLUTIONS

1 B is correct. Permot has the highest percentage of floating-coupon bonds and inflation-linked bonds. Bonds with floating coupons protect interest income from inflation because the reference rate should adjust for inflation. Inflation-linked bonds protect against inflation by paying a return that is directly linked to an index of consumer prices and adjusting the principal for inflation. Inflation-linked bonds protect both coupon and principal payments against inflation.

The level of inflation protection for coupons = % portfolio in floating-coupon bonds + % portfolio in inflation-linked bonds:

Aschel = 2% + 3% = 5%

Permot = 34% + 28% = 62%

Rosaiso = 17% + 21% = 38%

Thus, Permot has the highest level of inflation protection with 62% of its portfolio in floating-coupon and inflation-linked bonds.

2 B is correct. The rolling yield is the sum of the yield income and the rolldown return. Yield income is the sum of the bond's annual current yield and interest on reinvestment income. Perreaux assumes that there is no reinvestment income for any of the three funds, and the yield income for Aschel will be calculated as follows:

Yield income = Annual average coupon payment/Current bond price
= \$3.63/\$117.00
= 0.0310, or 3.10%.

The rolldown return is equal to the bond's percentage price change assuming an unchanged yield curve over the horizon period. The rolldown return will be calculated as follows:

$$\text{Rolldown return} = \frac{\left(\text{Bond price}_{\text{End-of-horizon period}} - \text{Bond price}_{\text{Beginning-of-horizon period}}\right)}{\text{Bond price}_{\text{Beginning-of-horizon period}}}$$

$$= \frac{(\$114.00 - \$117.00)}{\$117.00}$$

$$= -0.0256, \text{ or } -2.56\%$$

Rolling yield = Yield income + Rolldown return = 3.10% − 2.56% = 0.54%

3 B is correct. The return for Aschel is 7.71%, calculated as follows.

$$r_p = \frac{\left(r_l \times (V_E + V_B) - V_B \times r_B\right)}{V_E}$$

$$= r_l + \frac{V_B}{V_E}(r_l - r_B)$$

$$= 6.20\% + \frac{\$42.00 \text{ million}}{\$94.33 \text{ million}}(6.20\% - 2.80\%)$$

$$= 7.71\%$$

4 C is correct. Rosaiso is the only fund that holds bonds with embedded options. Effective duration should be used for bonds with embedded options. For bonds with embedded options, the duration and convexity measures used to calculate the expected change in price based on the investors's views of yields and yield spreads are effective duration and effective convexity. For bonds without embedded options, convexity and modified duration are used in this calculation.

5 B is correct. Cash flow matching has no yield curve or interest rate assumptions. With this immunization approach, cash flows come from coupon and principal repayments that are expected to match and offset liability cash flows. Because bond cash inflows are scheduled to coincide with liability cash payouts, there is no need for reinvestment of cash flows. Thus, cash flow matching is not affected by interest rate movements. Cash flows coming from coupons and liquidating bond portfolio positions is a key feature of a duration-matching approach.

6 A is correct. The optimal strategy for Villash is the sale of 100% of Bond 1, which Perreaux considers to be overvalued. Because Villash is a tax-exempt foundation, tax considerations are not relevant and Perreaux's investment views drive her trading recommendations.

7 B is correct. The domestic bond portfolio's return objective is to modestly outperform the benchmark. Its risk factors, such as duration, are to closely match the benchmark. Small deviations in sector weights are allowed, and tracking error should be less than 50 bps year. These features are typical of enhanced indexing.

8 A is correct. Floating-coupon bonds provide inflation protection for the interest income because the reference rate should adjust for inflation. The purchase of fixed-coupon bonds as outlined in Strategy 1 provides no protection against inflation for either interest or principal. Strategy 1 would instead be superior to Strategy 2 in funding future liabilities (better predictability as to the amount of cash flows) and reducing the correlation between the fund's domestic bond portfolio and equity portfolio (better diversification).

9 C is correct. Since the fund's clients are taxable investors, there is value in harvesting tax losses. These losses can be used to offset capital gains within the fund that will otherwise be distributed to the clients and cause them higher tax payments, which decreases the total value of the investment to clients. The fund has to consider the overall value of the investment to its clients, including taxes, which may result in the sale of bonds that are not viewed as overvalued. Tax-exempt investors' decisions are driven by their investment views without regard to offsetting gains and losses for tax purposes.

10 C is correct. Bond 3 is most likely to be the least liquid of the three bonds presented in Exhibit 2 and will thus most likely require the highest liquidity premium. Low credit ratings, longer time since issuance, smaller issuance size, smaller issuance outstanding, and longer time to maturity typically are associated with a lower liquidity (and thus a higher liquidity premium). Bond 3 has the lowest credit quality and the longest time since issuance of the three bonds. Bond 3 also has a smaller issue size and longer time to maturity than Bond 1. The total issuance outstanding for Bond 3 is smaller than that of Bond 2 and equal to that of Bond 1.

11 B is correct. The total expected return is calculated as:

Total expected return = Rolling yield + E(Change in price based on investor's yield and yield spread view) – E(Credit losses) + E(Currency gains or losses)

Rolling yield = Yield income + Rolldown return

Return Component	Formula	Calculation
Yield income	Annual coupon payment/Current bond price	€2.25/€98.45 = 2.29%
+ Rolldown return	$\frac{(\text{Bond price}_{\text{End-of-horizon period}} - \text{Bond price}_{\text{Beginning-of-horizon period}})}{\text{Bond price}_{\text{Beginning-of-horizon period}}}$	(€98.62 – €98.45)/ €98.45 = 0.17%
= Rolling yield	Yield income + Rolldown return	2.29% + 0.17% = 2.46%
+ E(Change in price based on investor's yield and yield spread view)	$[-\text{MD} \times \Delta\text{Yield}] + [\frac{1}{2} \times \text{Convexity} \times (\text{Yield})^2]$	$[-5.19 \times 0.0015] + [\frac{1}{2} \times 22 \times (0.0015)^2] = -0.78\%$
– E(Credit losses)	Given	–0.13%
+ E(Currency gains or losses)	Given	0.65%
= Total expected return		**2.20%**

12 C is correct. The sector weights, risk and return characteristics, and turnover for Manager C differ significantly from those of the index, which is typical of an active management mandate. In particular, Manager C's modified duration of 6.16 represents a much larger deviation from the benchmark index modified duration of 5.22 than that of the other managers, which is a characteristic unique to an active management mandate.