CFA® 2019 PROGRAM EXAM PREP

SchweserNotes™ Level III

Economic Analysis, Asset Allocation and Fixed-Income Portfolio Management

eBook 3

KAPLAN® SCHWESER

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16. Capital Market Expectations

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c. demonstrate the application of formal tools for setting capital market expectations, including statistical tools, discounted cash flow models, the risk premium approach, and financial equilibrium models. (page 7)
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STUDY SESSION 9

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The topical coverage corresponds with the following CFA Institute assigned reading:

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The topical coverage corresponds with the following CFA Institute assigned reading:

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The topical coverage corresponds with the following CFA Institute assigned reading:

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The topical coverage corresponds with the following CFA Institute assigned reading:

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The following is a review of the Applications of Economic Analysis to Portfolio Management principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #16.

READING 16: CAPITAL MARKET EXPECTATIONS

Study Session 8

EXAM FOCUS

Combining capital market expectations with the client's objectives and constraints leads to the portfolio's strategic asset allocation. A variety of economic tools and techniques are useful in forming capital market expectations for return, risk, and correlation by asset class. Unfortunately, no one technique works consistently, so be prepared for any technique and its issues as covered here.

MODULE 16.1: FORMULATING CAPITAL MARKET EXPECTATIONS

LOS 16.a: Discuss the role of, and a framework for, capital market expectations in the portfolio management process.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 7

Capital market expectations can be referred to as **macro expectations** (expectations regarding classes of assets) or **micro expectations** (expectations regarding individual assets). Micro expectations are most directly used in individual security selection. In other assignments, macro expectations are referred to as top-down while micro expectations are referred to as bottom-up.

Using a disciplined approach leads to more effective asset allocations and risk management. Formulating capital market expectations is referred to as **beta research** because it is related to systematic risk. It can be used in the valuation of both equities and fixed-income securities. **Alpha research**, on the other hand, is concerned with earning excess returns through the use of specific strategies within specific asset groups.

To formulate capital market expectations, the analyst should use the following 7-step process.

Step 1: Determine the specific capital market expectations needed according to the investor's tax status, allowable asset classes, and time horizon. Time horizon is particularly important in determining the set of capital market expectations that are needed.

Step 2: Investigate assets' historical performance to determine the drivers that have affected past performance and to establish some range for plausible future performance.

With the drivers of past performance established, the analyst can use these to forecast expected future performance as well as compare the forecast to past results to see if the forecast appears reasonable.

Step 3: Identify the valuation model used and its requirements. For example, a comparables-based, relative value approach used in the United States may be difficult to apply in an emerging market analysis.

Step 4: Collect the best data possible. The use of faulty data will lead to faulty conclusions. The following issues should be considered when evaluating data for possible use:

- Calculation methodologies.
- Data collection techniques.
- Data definitions.
- Error rates.
- Investability and correction for free float.
- Turnover in index components.
- Potential biases.

Step 5: Use experience and judgment to interpret current investment conditions and decide what values to assign to the required inputs. Verify that the inputs used for the various asset classes are consistent across classes.

Step 6: Formulate capital market expectations. Any assumptions and rationales used in the analysis should be recorded. Determine that what was specified in Step 1 has been provided.

Step 7: Monitor performance and use it to refine the process. If actual performance varies significantly from forecasts, the process and model should be refined.

PROBLEMS IN FORECASTING

LOS 16.b: Discuss challenges in developing capital market forecasts.

CFA® Program Curriculum, Volume 3, page 13

As mentioned earlier, poor forecasts can result in inappropriate asset allocations. The analyst should be aware of the potential problems in data, models, and the resulting capital market expectations. Nine problems encountered in producing forecasts are (1) limitations to using economic data, (2) data measurement error and bias, (3) limitations of historical estimates, (4) the use of ex post risk and return measures, (5) non-repeating data patterns, (6) failing to account for conditioning information, (7) misinterpretation of correlations, (8) psychological traps, and (9) model and input uncertainty.

1. There are several **limitations to using economic data**. First, the time lag between collection and distribution is often quite long. The International Monetary Fund, for example, reports data with a lag of as much as two years. Second, data are often revised and the revisions are not made at the same time as the publication. Third, data definitions and methodology change over time. For example, the basket of goods in the Consumer Price Index changes over time. Last, data indices

are often rebased over time (i.e., the base upon which they are calculated is changed). Although a rebasing is not a substantial change in the data itself, the unaware analyst could calculate changes in the value of the indices incorrectly if she does not make an appropriate adjustment.

2. There are numerous possible **data measurement errors and biases**. *Transcription errors* are the misreporting or incorrect recording of information and are most serious if they are biased in one direction. *Survivorship bias* commonly occurs if a manager or a security return series is deleted from the historical performance record of managers or firms. Deletions are often tied to poor performance and bias the historical return upward. *Appraisal* (smoothed) *data* for illiquid and infrequently priced assets makes the path of returns appear smoother than it actually is. This biases downward the calculated standard deviation and makes the returns seem less correlated (closer to 0) with more liquid priced assets. This is a particular problem for some types of alternative assets such as real estate. Rescaling the data based on underlying economic drivers can be used to leave the mean return unaffected but increase the variance.
3. The **limitations of historical estimates** can also hamper the formation of capital market expectations. The values from historical data must often be adjusted going forward as economic, political, regulatory, and technological environments change. This is particularly true for volatile assets such as equity. These changes are known as *regime changes* and result in *nonstationary* data. For example, the bursting of the technology bubble in 2000 resulted in returns data that were markedly different than that from the previous five years. Nonstationarity would mean different periods in the time series have different statistical properties and create problems with standard statistical testing methods.

   Historical data is the starting point for estimating the following capital market expectations: expected return, standard deviation, and correlations. However, it is not obvious how to select the time period of historical data. A long time period is preferable for several reasons.

   - It may be statistically required. To calculate historical covariance (and correlation), the number of data points must exceed the number of covariances to be calculated.
   - A larger data set (time period) provides more precise statistical estimates with smaller variance to the estimates.
   - As a related issue, if the time period is longer for a larger data set, the calculated statistics are generally less sensitive to the starting and ending points selected for the time period.

   However, long time periods also create potential problems.

   - A longer time period is more likely to include *regime changes*, which are shifts in underlying fundamentals. Each regime change creates a subperiod with distinctly different characteristics. For example, the behavior of real estate and virtually every financial asset was different before and after the

Financial Market Meltdown of 2008. 1) This creates *nonstationarity*, which invalidates many statistics calculated from time periods starting before and ending after the meltdown. 2) It forces the analyst to use judgment to decide whether the subperiod before or after the meltdown will be more relevant going forward.

- It may mean the relevant time period is too short to be statistically significant.
- It creates a temptation to use more frequent data, such as weekly data, rather than monthly data points in order to have a larger sample size. Unfortunately, more frequent data points are often more likely to have missing or outdated values (this is called *asynchronism*) and can result in lower, distorted correlation calculations.

Two questions can be used to help resolve the issue of time period to select:

a. Is there a reason to believe the entire (longer) time period is not appropriate?
b. If the answer to the first question is yes, does a statistical test confirm there is a regime change and the point in the time series where it occurs?

If both answers are yes, the analyst must use judgment to select the relevant sub period.

PROFESSOR'S NOTE

I hope most candidates recognize the discussions above have been referring to many of the statistical testing issues covered at Level I and II. The focus here is not on performing such tests or even knowing which specific tests to use, but on recognizing times and ways testing can be relevant. Think of a senior portfolio manager who understands the larger issues and when to ask others with relevant technical skills to do further analysis. This is a common perspective at Level III.

4. Using **ex post data** (after the fact) to determine **ex ante** (before the fact) risk and return can be problematic. For example, suppose that several years ago investors were fearful that the Federal Reserve was going to have to raise interest rates to combat inflation. This situation would cause depressed stock prices. If inflation abated without the Fed's intervention, then stock returns would increase once the inflation scenario passes. Looking back on this situation, the researcher would conclude that stock returns were high while being blind to the prior risk that investors had faced. The analyst would then conclude that future (ex ante) returns for stocks will be high. In sum, the analyst would underestimate the risks that equity investors face and overestimate their potential returns.
5. Using historical data, analysts can also uncover **patterns** in security returns that are unlikely to occur in the future and can produce biases in the data. One such bias is *data mining*. Just by random chance, some variables will appear to have a relationship with security returns, when, in fact, these relationships are unlikely to persist. For example, if the analyst uses a 5% significance level and examines the relationship between stock returns and 40 randomly selected variables, two (5%) of the variables are expected to show a statistically significant relationship with stock returns just by random chance. Another potential bias results from the time

span of data chosen (*time period bias*). For example, small-cap U.S. stocks are widely thought to outperform large-cap stocks, but their advantage disappears when data from the 1970s and 1980s is excluded.

To avoid these biases, the analyst should first ask himself if there is any economic basis for the variables found to be related to stock returns. Second, he should scrutinize the modeling process for susceptibility to bias. Third, the analyst should test the discovered relationship with out-of-sample data to determine if the relationship is persistent. This would be done by estimating the relationship with one portion of the historical data and then reexamining it with another portion.

6. Analysts' forecasts may also fail to account for **conditioning information**. The relationship between security returns and economic variables is not constant over time. Historical data reflects performance over many different business cycles and economic conditions. Thus, analysts should account for current conditions in their forecasts. As an example, suppose a firm's beta is estimated at 1.2 using historical data. If, however, the original data are separated into two ranges by economic expansion or recession, the beta might be 1.0 in expansions and 1.4 in recessions. Going forward, the analyst's estimate of the firm's beta should reflect whether an expansion is expected (i.e., the expected beta is 1.0) or a recession is expected (i.e., the expected beta is 1.4). The beta used should be the beta consistent with the analyst's expectations for economic conditions.
7. Another problem in forming capital market expectations is the **misinterpretation of correlations** (i.e., causality). Suppose the analyst finds that corn prices were correlated with rainfall in the Midwestern United States during the previous quarter. It would be reasonable to conclude that rainfall influences corn prices. It would not be reasonable to conclude that corn prices influence rainfall, although the correlation statistic would not tell us that. Rainfall is an exogenous variable (i.e., it arises outside the model), whereas the price of corn is an endogenous variable (i.e., it arises within the model).

   It is also possible that a third variable influences both variables. Or it is possible that there is a nonlinear relationship between the two variables that is missed by the correlation statistic, which measures linear relationships.

   These scenarios illustrate the problem with the simple correlation statistic. An alternative to correlation for uncovering predictive relationships is a multiple regression. In a multiple regression, lagged terms, control variables, and nonlinear terms can all be included as independent variables to better specify the relationship. Controlling for other effects, the regression coefficient on the variable of interest is referred to as the *partial correlation* and would be used for the desired analysis.
8. Analysts are also susceptible to **psychological traps**:
   - In the **anchoring trap**, the first information received is overweighted. If during a debate on the future of the economy, the first speaker forecasts a recession, that forecast is given greater credence.

- In the **status quo trap**, predictions are highly influenced by the recent past. If inflation is currently 4%, that becomes the forecast, rather than choosing to be different and potentially making an active error of commission.
- In the **confirming evidence trap**, only information supporting the existing belief is considered, and such evidence may be actively sought while other evidence is ignored. To counter these tendencies, analysts should give all evidence equal scrutiny, seek out opposing opinions, and be forthcoming in their motives.
- In the **overconfidence trap**, past mistakes are ignored, the lack of comments from others is taken as agreement, and the accuracy of forecasts is overestimated. To counter this trap, consider a range of potential outcomes.
- In the **prudence trap**, forecasts are overly conservative to avoid the from making extreme forecasts that could end up being incorrect. To counter this trap, consider a range of potential outcomes.
- In the **recallability trap**, what is easiest to remember (often an extreme event) is overweighted. Many believe that the U.S. stock market crash of 1929 may have depressed equity values in the subsequent 30 years. To counter this trap, base predictions on objective data rather than emotions or recollections of the past.

PROFESSOR'S NOTE

Nothing to dwell on here. Just one more discussion of behavioral biases.

9. **Model and input uncertainty**. Model uncertainty refers to selecting the correct model. An analyst may be unsure whether to use a discounted cash flow (DCF) model or a relative value model to evaluate expected stock return. Input uncertainty refers to knowing the correct input values for the model. For example, even if the analyst knew that the DCF model was appropriate, the correct growth and discount rates are still needed.

Tests of market efficiency usually depend on the use of a model. For example, many researchers use the market model and beta as the relevant measure of risk. If beta is not the correct measure of risk, then the conclusions regarding market efficiency will be invalid. Some believe that market anomalies, which have been explained by behavioral finance, are in fact due to the actions of investors who are rational but use different valuation models (which include the human limitations of cognitive errors and emotional biases).

MODULE QUIZ 16.1

To best evaluate your performance, enter your quiz answers online.

1. An analyst uses a variety of valuation approaches for different asset classes and collects the necessary data from multiple sources. The analyst does not make any effort to systematically compare the data used. As a result, the analyst uses relatively low discount rates for equity analysis (overestimating theoretical value) and high discount rates for fixed income (underestimating theoretical value).

Discuss the likely effect on the analyst's asset allocation recommendations.

2. An analyst would like to forecast U.S. equity returns. He is considering using either the last 3 years of historical annual returns or the last 50 years of historical annual returns. **Provide** an argument for and against each selection of data length.

3. **Explain** why smoothed data may be used for some types of alternative investments and the consequences for the expected return, risk, and correlation to other assets from using such data.

MODULE 16.2: STATISTICAL TOOLS AND DISCOUNTED CASH FLOW MODELS

LOS 16.c: Demonstrate the application of formal tools for setting capital market expectations, including statistical tools, discounted cash flow models, the risk premium approach, and financial equilibrium models.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 23

The use of formal tools helps the analyst set capital market expectations. Formal tools are those that are accepted within the investment community. When applied to reputable data, formal tools provide forecasts replicable by other analysts. The formal tools we examine are statistical tools, discounted cash flow models, the risk premium approach, and financial equilibrium models.

Statistical Tools

Descriptive statistics summarize data. **Inferential statistics** use the data to make forecasts. If the past data is **stationary**, the parameters driving the past and the future are unchanged. Therefore, the historical estimates are reasonable estimates of the future.

Return estimates can be based on the arithmetic or geometric average of past returns.

To estimate the return in a single period, the arithmetic average is used. For example, if a portfolio has a 50/50 chance of making or losing 10% in any given period, there is an equal chance $100 will increase to $110 or decrease to $90. Thus, on average, the portfolio is unchanged at $100 for a 0% return, the arithmetic average of the + and – 10% returns.

Over multiple periods, the geometric average is generally preferred. Unannualized, the geometric return of the portfolio is (1.10)(0.90) − 1 = –1.0%. This reflects the most likely value of the portfolio over two periods, as the $100 could either increase 10% to $110 and then decline 10% to $99, or decrease 10% to $90 and then increase 10% to $99. Under either path, the most likely change is –1%.

Another approach is to use the historical equity risk premium plus a current bond yield to estimate the expected return on equities.

Alternatively, a **shrinkage estimate** can be applied to the historical estimate if the analyst believes simple historical results do not fully reflect expected future conditions. A shrinkage estimate is a weighted average estimate based on history and some other projection.

For example, suppose the historical covariance between two assets is 180 and the analyst has used a model to project covariances and develop a **target covariance matrix**). If the model estimated covariance is 220 and the analyst weights the historical covariance by 60% and the target by 40%, the shrinkage estimate would be 196 (= 180 × 0.60 + 220 × 0.40). If conditions are changing and the model and weights are well chosen, the shrinkage estimate covariances are likely to be more accurate.

Time series models are also used to make estimates. A time series model assumes the past value of a variable is, at least in part, a valid estimator of its future value. Time series models are frequently used to make estimates of near term volatility. **Volatility clustering** has been observed where either high or low volatility tends to persist, at least in the short run. A model developed by JP Morgan states that variance in the next period (σ_t^2) is a weighted average of the previous period variance and the square of the residual error. The two weights sum to 1.0 and can be denoted as β and 1 − β.

PROFESSOR'S NOTE

Some authors use θ rather than β to denote the weights. β is a generic symbol used to denote weight or exposure to a factor.

$$\sigma_t^2 = \beta\sigma_{t-1}^2 + (1-\beta)\,\varepsilon_t^2$$

For example, suppose β is 0.80 and the standard deviation in returns is 15% in period t – 1. If the random error is 0.04, then the forecasted variance for period *t* is:

$$\sigma_t^2 = 0.80\left(0.15^2\right) + 0.20\left(0.04^2\right) = 0.01832$$

$$\sigma_t = \sqrt{0.01832} = 0.1354 = 13.54\%$$

The forecasted standard deviation of 13.54% is close to the historical standard deviation of 15% because the historical standard deviation is weighted so heavily.

Multifactor models can be used in a top down analysis to forecast returns based on sensitivities (β) and risk factors (F). A two-factor model would take the form:

$$R_i = \alpha_i + \beta_{i,1}F_1 + \beta_{i,2}F_2 + \varepsilon_i$$

In this two-factor model, returns for an asset *i*, R_i, are a function of factor sensitivities, β, and factors, *F*. A random error, ε_i, has a mean of zero and is uncorrelated with the factors.

A rigorous approach can be used to work through a sequence of analysis levels and a consistent set of data to calculate expected return, covariance, and variance across markets. For example, Level 1 may consider the factors which affect broad markets, such as global equity and bond. Level 2 then proceeds to more specific markets, such as market *i*, *j*, *k*, *l*. In turn, further levels of analysis can be conducted on sectors within each market (for example, within market *l*).

The advantages of this approach include the following:

- Returns, covariances, and variances are all derived from the same set of driving risk factors (betas).
- A set of well-chosen, consistent factors reduces the chance for random variation in the estimates.
- Such models allow for testing the consistency of the covariance matrix.

The choice of factors to consider and levels of analysis is up to the analyst.

PROFESSOR'S NOTE

The following example illustrates this analysis method. This type of hard core statistical calculation is not common on the exam. The CFA® text has one similar example but no end of chapter questions on the topic.

In this reading you will see "inconsistencies" of scale. Do not let them throw you off. The key issue **within any one question is to be consistent using only whole numbers or decimal versions for standard deviation, covariance, and variance.**

For example, in shrinkage estimators, covariance is presented as the whole number 220. It can also be shown as 0.0220. In the time series discussion, standard deviation was expressed as the decimal 0.15 (for 15%). In the following example and in the corresponding CFA example, decimals are used with 0.0211 for variance and 0.0015 for covariance. It is up to you to know the material well enough to interpret the scale of the data in a given question. For example, 15% standard deviation and its variance can be expressed as 15 and 225 in whole numbers or as 0.15 and 0.0225 in decimal numbers.

EXAMPLE: Two-Level Factor Analysis

Thom Jones is a senior strategist examining equity and bond markets in countries C and D. He assigns the quantitative group to prepare a series of consistent calculations for the two markets. The group begins at Level 1 by assuming there are two factors driving the returns for all assets—a global equity factor and a global bond factor. At Level 2, this data is used to analyze each market. The data used is shown in Figure 16.1 and Figure 16.2:

Figure 16.1: Factor Covariance Matrix for Global Assets

	Global Equity Factor	Global Bond Factor
Global equity factor	$0.0211 = \sigma_{F1}{}^2$	$0.0015 = \text{cov}(F_1,F_2)$
Global bond factor	$0.0015 = \text{cov}(F_1,F_2)$	$0.0019 = \sigma_{F2}{}^2$

Figure 16.2: Factor Sensitivities for Countries

Country	Global Equity	Global Fixed Income
C	$0.90 = \beta_{C1}$	$0.00 = \beta_{C2}$
D	$0.80 = \beta_{D1}$	$0.00 = \beta_{D2}$

The 0.00 sensitivities to global fixed income in country markets C and D indicate both markets are equity markets. (Note that this does not mean the pairwise correlation between each market and the global bond market is zero. It means that, once the effect of the equity market is controlled for, the *partial correlation* of each market and the global bond factor is zero.)

Estimate the covariance between markets C and D:

$$\begin{aligned}\text{Cov}(\text{C},\text{D}) = {} & \beta_{\text{C},1}\beta_{\text{D},1}\sigma^2_{\text{F}_1} + \beta_{\text{C},2}\beta_{\text{D},2}\sigma^2_{\text{F}_2} \\ & + \left(\beta_{\text{C},1}\beta_{\text{D},2} + \beta_{\text{C},2}\beta_{\text{D},1}\right)\text{Cov}(\text{F}_1,\text{F}_2)\end{aligned}$$

???

Cov(C,D) = (0.90)(0.80)(0.0211) + (0)(0)(0.0019) + [(0.90)(0) + (0.00)(0.80)]0.0015 = 0.0152

Estimate the variance for market C:

$$\sigma^2_{\text{C}} = \beta^2_{\text{C},1}\sigma^2_{\text{F}_1} + \beta^2_{\text{C},2}\sigma^2_{\text{F}_2} + 2\beta_{\text{C},1}\beta_{\text{C},2}\text{Cov}(\text{F}_1,\text{F}_2) + \sigma^2_{\varepsilon,\text{C}}$$

$(0.90)^2(0.0211) + (0.00)^2(0.0019) + 2(0.90)(0.00)(0.0015) = 0.0171$

For market D, this is:

$(0.80)^2(0.0211) + (0.00)^2(0.0019) + 2(0.80)(0.00)(0.0015) = 0.0135$

Note that the variance of the markets will be higher than estimated because the analysis has not accounted for the variance of residual risk ($\sigma^2\varepsilon$). Each market will have residual or idiosyncratic risk not explained by that market's factor sensitivities.

Discounted Cash Flow Models

A second tool for setting capital market expectations is **discounted cash flow models**. These models say that the intrinsic value of an asset is the present value of future cash flows. The advantage of these models is their correct emphasis on the future cash flows of an asset and the ability to back out a required return. Their disadvantage is that they do not account for current market conditions such as supply and demand, so these models are viewed as being more suitable for long-term valuation.

Applied to equity markets, the most common application of discounted cash flow models is the Gordon growth model or constant growth model. It is most commonly used to back out the expected return on equity, resulting in the following:

$$P_0 = \frac{Div_1}{\hat{R}_{i-g}} \Rightarrow \hat{R}_i = \frac{Div_1}{P_0} + g$$

where:

$\hat{R}_i$ = expected return on stock *i*

Div_1 = divident next period

P_0 = current stock price

g = growth rate in dividends and long-term earnings

This formulation can be applied to entire markets as well. In this case, the growth rate is proxied by the nominal growth in GDP, which is the sum of the real growth rate in GDP plus the rate of inflation. The growth rate can be adjusted for any differences between the economy's growth rate and that of the equity index. This adjustment is referred to as the *excess corporate growth rate*. For example, the analyst may project the U.S. real growth in GDP at 2%. If the analyst thinks that the constituents of the Wilshire 5000 index will grow at a rate 1% faster than the economy as a whole, the projected growth for the Wilshire 5000 would be 3%.

Grinold and Kroner (2002)[1] take this model one step further by including a variable that adjusts for stock repurchases and changes in market valuations as represented by the price-earnings (P/E) ratio. The model states that the expected return on a stock is its dividend yield plus the inflation rate plus the real earnings growth rate minus the change in stock outstanding plus changes in the P/E ratio:

$$\hat{R}_i = \frac{D_1}{P_0} + i + g - \Delta S + \Delta\left(\frac{P}{E}\right)$$

where:

$\hat{R}_i$ = expected return on stock i; referred to as *compound annual growth rate* on a Level III exam

$\frac{D_1}{P_0}$ = expected divident yield

i = expected inflation

g = real growth rate

ΔS = percentage change in shares outstanding (positive or negative)

$\left(\frac{P}{E}\right)$ = percentage change in the P/E ration (repricing term)

The variables of the Grinold-Kroner model can be grouped into three components: the expected income return, the expected nominal growth in earnings, and the expected repricing return.

1. The **expected income return** is the cash flow yield for that market:

$$\text{expected income return} = \left(\frac{D_1}{P_0} - \Delta S\right)$$

   D_1 / P_0 is current yield as seen in the constant growth dividend discount model. It is the expected dividend expressed as a percentage of the current price. The Grinold-Kroner model goes a step further in expressing the expected current yield by considering any repurchases or new issues of stock.

   PROFESSOR'S NOTE

   To keep the ΔS analysis straight, just remember net stock:

   - Repurchase increases cash flow to investors and increases expected return.
   - Issuance decreases cash flow to investors and decreases expected return.

   The long way around to reaching these conclusions is:

   - Repurchase is a reduction in shares outstanding, and $-\Delta S$, when subtracted in GK, is $-(-\Delta S)$, which becomes $+\Delta S$ and an addition to expected return.
   - Issuance is an increase in shares outstanding, and $+\Delta S$, when subtracted in GK, becomes $-\Delta S$ and a reduction in expected return.

2. The **expected nominal earnings growth** is the real growth in the stock price plus expected inflation (think of a nominal interest rate that includes the real rate plus inflation):

   expected nominal earnings growth = (i + g)

3. The **repricing return** is captured by the expected change in the P/E ratio:

   expected repricing return $= \Delta \frac{P}{E}$

It is helpful to view the Grinold-Kroner model as the sum of the expected income return, the expected nominal growth, and the expected repricing return.

$$\begin{aligned}\widehat{R}_i &= \exp\left(\text{income return}\right) + \exp\left(\text{nominal earnings growth}\right) \\ &\quad + \exp\left(\text{repricing return}\right) \\ \widehat{R}_i &= \left(\frac{D_1}{P_0} - \quad S\right) + (i + g) + \left(\quad \frac{P}{E}\right)\end{aligned}$$

Suppose an analyst estimates a 2.1% dividend yield, real earnings growth of 4.0%, long-term inflation of 3.1%, a repurchase yield of –0.5%, and P/E re-pricing of 0.3%:

$$\begin{aligned} \text{expected}current yield\,(\text{income return}) &= \text{dividend yield} + \text{repurchase yie} \\ &= 2.1\% - 0.5\% = 1.6\% \end{aligned}$$

$$\begin{gathered} \text{expected}capital gains yield \\ = \text{real growth} + \text{inflation} - \text{re-pricing} \\ = 4.0\% + 3.1\% = 0.3\% = 7.4\% \end{gathered}$$

The total expected return on the stock market is 1.6% + 7.4% = 9.0%.

Estimating Fixed Income Returns

Discounted cash flow analysis of fixed income securities supports the use of YTM as an estimate of expected return. YTM is an IRR calculation and, like any IRR calculation, it will be the realized return earned if the cash flows are reinvested at the YTM and the bond is held to maturity. For zero-coupon bonds, there are no cash flows to reinvest, though the held-to-maturity assumption still applies. Alternatively, the analyst can make other reinvestment and holding period assumptions to project expected return.

MODULE QUIZ 16.2

To best evaluate your performance, enter your quiz answers online.

1. An analyst realizes that the variance for an exchange rate tends to persist over a period of time, where high volatility is followed by more high volatility. What statistical tool would the analyst *most likely* use to forecast the variance of the exchange rate?

2. At the beginning of the fiscal year, Tel-Pal, Inc., stock sells for $75 per share. There are 2,000,000 shares outstanding. An analyst predicts that the annual dividend to be paid in one year will be $3 per share. The expected inflation rate is 3.5%. The firm plans to issue 40,000 new shares over the year. The price-to-earnings ratio is expected to stay the same, and nominal earnings will increase by 6.8%. Based upon these figures, what is the expected return on a share of Tel-Pal, Inc., stock in the next year?

3. An analyst forecasts the historical covariance of the returns between Tel-Pal, Inc., stock and Int-Pal, Inc., stock to be 1,024. A newly forecasted covariance matrix

predicts the covariance will be 784. The analyst weights the historical covariance at 30% and the forecast at 70%. **Calculate** the shrinkage estimate of the covariance.

MODULE 16.3: RISK PREMIUMS, FINANCIAL EQUILIBRIUM, AND SURVEYS

An alternative to estimating expected return using YTM is a risk premium or buildup model. Risk premium approaches can be used for both fixed income and equity. The approach starts with a lower risk yield and then adds compensation for risks. A typical fixed income buildup might calculate expected return as:

Video covering this content is available online.

RB = real risk-free rate + inflation risk premium + default risk premium + illiquidity risk premium + maturity risk premium + tax premium

- The inflation premium compensates for a loss in purchasing power over time.
- The default risk premium compensates for possible non-payment.
- The illiquidity premium compensates for holding illiquid bonds.
- The maturity risk premium compensates for the greater price volatility of longer-term bonds.
- The tax premium accounts for different tax treatments of some bonds.

To calculate an expected equity return, an equity risk premium would be added to the bond yield.

PROFESSOR'S NOTE

Equity buildup models vary in the starting point.

- Begin with r_f. The Security Market Line starts with r_f and can be considered a variation of this approach.
- Other models start with a long-term default free bond.
- Or the corporate bond yield of the issuer.

The point is to use the data provided.

Financial Equilibrium Models

The financial equilibrium approach assumes that supply and demand in global asset markets are in balance. In turn, financial models will value securities correctly. One such model is the International Capital Asset Pricing Model (ICAPM). The Singer and Terhaar approach begins with the ICAPM.

The equation for the ICAPM is:

$$\widehat{R}_i = R_F + \beta_i \left(\widehat{R}_M - R_F \right)$$

where:

$\widehat{R}_i$ = expected return on asset *i*

R_F = risk-free rate of return

β_i = sensitivity (systematic risk)of asset *i* returns to the global investable market

$\widehat{R}_M$ = expected return on the *global* investable market

Think of the global investable market as consisting of all investable assets, traditional and alternative.

We can manipulate this formula to solve for the risk premium on a debt or equity security using the following steps:

Step 1: The relationship between the covariance and correlation is:

$$\rho_{i,M} = \frac{\mathrm{Cov}\,(i, m)}{\sigma_i \sigma_M} \Rightarrow \mathrm{Cov}(i, m) = \rho_{i,M} \sigma_i \sigma_M$$

where:

$\rho_{i,M}$ = correlation between the returns on asset *i* and the global market portfolio

σ_i = standard deviation of the returns on asset *i*

σ_M = standard deviation of the returns on the global market portfolio

Step 2: Recall that:

$$\beta_i = \frac{\mathrm{Cov}\,(i, m)}{\sigma_M^2}$$

where:

Cov(i,m) = covariance of asset *i* with the global market portfolio

σ_M^2 = variance of the returns on the global market portfolio

Step 3: Combining the two previous equations and simplifying:

$$\beta_i = \frac{\rho_{i,M} \sigma_i \sigma_M}{\sigma_M^2} = \frac{\rho_{i,M} \sigma_i}{\sigma_M}$$

Step 4: Rearranging the ICAPM, we arrive at the expression for the risk premium for asset *i*, RP_i:

$$\widehat{R}_i = R_F + \beta_i\left(\widehat{R}_M - R_F\right)$$
$$\widehat{R}_i - R_F = \beta_i\left(\widehat{R}_M - R_F\right)$$
$$\text{denoting}\widehat{R}_i - R_F\,\text{as}\;RP_i$$
$$RP_i = \beta_i\left(\widehat{R}_M - R_F\right)\text{; and since}\beta_i = \rho_{i,M}\frac{\sigma_i}{\sigma_M}$$
$$RP_i = \rho_{i,M}\frac{\sigma_i}{\sigma_M}\left(\widehat{R}_M - R_F\right)\text{, or}$$
$$RP_i = \rho_{i,M}\sigma_i\left(\frac{\widehat{R}_M - R_F}{\sigma_M}\right)$$
$$\text{Note that}\left(\frac{\widehat{R}_M - R_F}{\sigma_M}\right) = \text{market Sharpe ratio}$$
$$\widehat{R}_M - R_F\,\text{is the market risk premium.}$$

The final expression states that the risk premium for an asset is equal to its correlation with the global market portfolio multiplied by the standard deviation of the asset multiplied by the Sharpe ratio for the global portfolio (in parentheses). From this formula, we forecast the risk premium and expected return for a market.

EXAMPLE: Calculating an equity risk premium and a debt risk premium

Given the following data, **calculate** the equity and debt risk premiums for Country X:

	Expected Standard Deviation	Correlation With Global Investable Market
Country X bonds	10%	0.40
Country X equities	15%	0.70
Market Sharpe ratio = 0.35		

$$RP_{bonds} = 10\% \times 0.40 \times 0.35 = 1.40\%$$

$$RP_{equities} = 15\% \times 0.70 \times 0.35 = 3.68\%$$

The Singer and Terhaar analysis then adjusts the ICAPM for market imperfections, such as illiquidity and segmentation. The more illiquid an asset is, the greater the liquidity risk premium should be. Liquidity is not typically a concern for developed world capital markets, but it can be a concern for assets such as direct real estate and private equity funds. In the case of private equity, an investment is usually subject to a lock-up period.

To estimate the size of the liquidity risk premium, one could estimate the *multi-period Sharpe ratio* for the investment over the time until it is liquid and compare it to the estimated multi-period Sharpe ratio for the market. The Sharpe ratio for the illiquid asset must be at least as high as that for the market. For example, suppose a venture capital investment has a lock-up period of five years and its multi-period Sharpe ratio is below that of the market's. If its expected return from the ICAPM is 16%, and the return necessary to equate its Sharpe ratio to that of the market's was 25%, then the liquidity premium would be 9%.

When markets are segmented, capital does not flow freely across borders. The opposite of segmented markets is integrated markets, where capital flows freely. Government restrictions on investing are a frequent cause of market segmentation. If markets are segmented, two assets with the same risk can have different expected returns because capital cannot flow to the higher return asset. The presence of investment barriers increases the risk premium for securities in segmented markets.

In reality, most markets are not fully segmented or integrated. For example, investors have a preference for their own country's equity markets (the *home country bias*). This prevents them from fully exploiting investment opportunities overseas. Developed world equity markets have been estimated as 80% integrated, whereas emerging market equities have been estimated as 65% integrated. In the example to follow, we will adjust for partial market segmentation by estimating an equity risk premium assuming full integration and an equity risk premium assuming full segmentation, and then taking a weighted average of the two. Under the full segmentation assumption, the relevant global portfolio is the individual market so that the correlation between the market and the global portfolio in the formula is 1. In that case, the equation for the market's risk premium reduces to:

$$\text{if} \rho_{\mathrm{i,M}} = 1 \Rightarrow \mathrm{ERP_i} = \sigma_{\mathrm{i}} \left(\frac{\mathrm{ERP_M}}{\sigma_{\mathrm{M}}} \right)$$

In the following example, we will calculate the equity risk premium for the two markets, their expected returns, and the covariance between them. Before we start, recall from our discussion of factor models that the covariance between two markets given two factors is:

$$\mathrm{Cov}\,(\mathrm{i,j}) = \beta_{\mathrm{i},1}\beta_{\mathrm{j},1}\sigma^2_{\mathrm{F_1}} + \beta_{\mathrm{i},2}\beta_{\mathrm{j},2}\sigma^2_{\mathrm{F_2}} + (\beta_{\mathrm{i},1}\beta_{\mathrm{j},2} + \beta_{\mathrm{i},2}\beta_{\mathrm{j},1})\,\mathrm{Cov}\,(\mathrm{F_1,F_2})$$

????

If there is only one factor driving returns (i.e., the global portfolio), then the equation reduces to:

$$\mathrm{Cov}\,(\mathrm{i,j}) = \beta_{\mathrm{i}}\beta_{\mathrm{j}}\sigma^2_{\mathrm{M}}$$

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EXAMPLE: Using market risk premiums to calculate expected returns, betas, and covariances

Suppose an analyst is valuing two equity markets. Market A is a developed market, and Market B is an emerging market. The investor's time horizon is five years. The other pertinent facts are:

Sharpe ratio of the global investable portfolio	0.29
Standard deviation of the global investable portfolio	9%
Risk-free rate of return	5%
Degree of market integration for Market A	80%
Degree of market integration for Market B	65%
Standard deviation of Market A	17%
Standard deviation of Market B	28%
Correlation of Market A with global investable portfolio	0.82
Correlation of Market B with global investable portfolio	0.63
Estimated illiquidity premium for A	0.0%
Estimated illiquidity premium for B	2.3%

Calculate the assets' expected returns, betas, and covariance.

Answer:

First, we calculate the equity risk premium for both markets assuming full integration. Note that for the emerging market, the illiquidity risk premium is included:

$ERP_i = \rho_{i,M}\sigma_i$(market Sharpe ratio)

$ERP_A = (0.82)(0.17)(0.29) = 4.04\%$

$ERP_B = (0.63)(0.28)(0.29) + 0.0230 = 7.42\%$

Next, we calculate the equity risk premium for both markets assuming full segmentation:

$ERP_i = \sigma_i$(market Sharpe ratio)

$ERP_A = (0.17)(0.29) = 4.93\%$

$ERP_B = (0.28)(0.29) + 0.0230 = 10.42\%$

Note that when we calculate the risk premium under full segmentation, we use the local market as the reference market instead of the global market, so the correlation between the local market and itself is 1.0.

We then weight the integrated and segmented risk premiums by the degree of integration and segmentation in each market to arrive at the weighted average equity risk premium.

ERP_i = (degree of integration of *i*)(ERP assuming full integration) + (degree of segmentation of *i*)(ERP assuming full segmentation)

$ERP_A = (0.80)(0.0404) + (1 - 0.80)(0.0493) = 4.22\%$

$ERP_B = (0.65)(0.0742) + (1 - 0.65)(0.1042) = 8.47\%$

The expected return in each market figures in the risk-free rate:

$$\widehat{R}_A = 5\% + 4.22\% = 9.22\%$$

$$\widehat{R}_B = 5\% + 8.46\% = 13.47\%$$

The betas in each market, which will be needed for the covariance, are calculated as:

$$\beta_i = \frac{\rho_{i,M}\sigma_i}{\sigma_M}$$

$$\beta_A = \frac{(0.82)(17)}{9} = 1.55$$

$$\beta_B = \frac{(0.63)(28)}{9} = 1.96$$

Lastly, we calculate the covariance of the two equity markets:

$$\text{Cov}(i,j) = \beta_i \beta_j \sigma_M^2$$

$$\text{Cov}(A,B) = (1.55)(1.96)(9.0)^2 = 246.08$$

PROFESSOR'S NOTE

Theoretically, a fully segmented market's Sharpe ratio would be independent of the world market Sharpe ratio. However, the CFA text makes the simplifying assumption to use the world market Sharpe ratio in both the segmented and integrated calculations. This is a reasonable assumption as we are valuing partially integrated/segmented markets. There is no reason to analyze the fully segmented market as outsiders **cannot**, by definition, invest in such markets.

THE USE OF SURVEYS AND JUDGMENT FOR CAPITAL MARKET EXPECTATIONS

LOS 16.d: Explain the use of survey and panel methods and judgment in setting capital market expectations.

CFA® Program Curriculum, Volume 3, page 48

Capital market expectations can also be formed using **surveys**. In this method, a poll is taken of market participants, such as economists and analysts, as to what their expectations are regarding the economy or capital market. If the group polled is fairly constant over time, this method is referred to as a **panel method**. For example, the U.S. Federal Reserve Bank of Philadelphia conducts an ongoing survey regarding the U.S. consumer price index, GDP, and so forth.[2]

Judgment can also be applied to project capital market expectations. Although quantitative models provide objective numerical forecasts, there are times when an analyst must adjust those expectations using their experience and insight to improve upon those forecasts.

MODULE 16.4: THE BUSINESS CYCLE

LOS 16.e: Discuss the inventory and business cycles and the effects that consumer and business spending and monetary and fiscal policy have on the business cycle.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 50

The Inventory and Business Cycle

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Understanding the business cycle can help the analyst identify *inflection points* (i.e., when the economy changes direction), where the risk and the opportunities for higher return may be heightened. To identify inflection points, the analyst should understand what is driving the current economy and what may cause the end of the current economy.

In general, economic growth can be partitioned into two components: (1) cyclical and (2) trend-growth components. The former is more short-term whereas the latter is more relevant for determining long-term return expectations. We will discuss the cyclical component first.

Within cyclical analysis, there are two components: (1) the inventory cycle and (2) the business cycle. The former typically lasts two to four years whereas the latter has a typical duration of nine to eleven years. These cycles vary in duration and are hard to predict because wars and other events can disrupt them.

Changes in economic activity delineate cyclical activity. The measures of economic activity are GDP, the output gap, and a recession. GDP is usually measured in real terms because true economic growth should be adjusted for inflationary components. The **output gap** is the difference between GDP based on a long-term trend line (i.e., potential GDP) and the current level of GDP. When the trend line is higher than the current GDP, the economy has slowed and inflationary pressures have weakened. When it is lower, economic activity is strong, as are inflationary pressures. This relationship is used by policy makers to form expectations regarding the appropriate level of growth and inflation. The relationship is affected by changes in technology and demographics. The third measure of economic activity, a **recession**, is defined as decreases (i.e., negative growth) in GDP over two consecutive quarters.

The **inventory cycle** is thought to be 2 to 4 years in length. It is often measured using the inventory to sales ratio. The measure increases when businesses gain confidence in the future of the economy and add to their inventories in anticipation of increasing demand for their output. As a result, employment increases with subsequent increases in economic growth. This continues until some precipitating factor, such as a tightening in the growth of the money supply, intervenes. At this point, inventories decrease and employment declines, which causes economic growth to slow.

When the inventory measure has peaked in an economy, as in the United States in 2000, subsequent periods exhibit slow growth as businesses sell out of their inventory. When it bottoms out, as in 2004, subsequent periods have higher growth as businesses restock their inventory. The long-term trend in this measure has been downward due to more effective inventory management techniques such as just-in-time inventory management.

The longer-term **business cycle** is thought to be 9 to 11 years in length. It is characterized by five phases: (1) the initial recovery, (2) early upswing, (3) late upswing, (4) slowdown, and (5) recession. We discuss the business cycle in greater detail later when we examine its effect on asset returns.

LOS 16.f: Discuss the effects that the phases of the business cycle have on short-term/long-term capital market returns.

CFA® Program Curriculum, Volume 3, page 52

> **For the Exam:** Have a working knowledge of, and be able to explain, the general relationships between interest rates, inflation, stock and bond prices, inventory levels, et cetera, as you progress over the business cycle. For example, as the peak of the cycle approaches, everything is humming along. Confidence and employment are high, but inflation is starting to have an impact on markets. As inflation increases, bond yields increase and both bond and stock prices start to fall.

The Business Cycle and Asset Returns

The relationship between the business cycle and assets returns is well-documented. Assets with higher returns during business cycle lows (e.g., bonds and defensive stocks) should be favored by investors because the returns supplement their income during recessionary periods. These assets should have lower risk premiums. Assets with lower returns during recessions should have higher risk premiums. Understanding the relationship between an asset's return and the business cycle can help the analyst provide better valuations.

As mentioned before, inflation varies over the business cycle, which has five phases: (1) initial recovery, (2) early expansion, (3) late expansion, (4) slowdown, and (5) recession. Inflation rises in the latter stages of an expansion and falls during a recession and the initial recovery. The phases have the following characteristics:

Initial Recovery

- Duration of a few months.
- Business confidence is rising.
- Government stimulation is provided by low interest rates and/or budget deficits.
- Falling inflation.
- Large output gap
- Low or falling short-term interest rates.
- Bond yields are bottoming out.
- Rising stock prices.
- Cyclical, riskier assets such as small-cap stocks and high yield bonds do well.

Early Upswing

- Duration of a year to several years.
- Increasing growth with low inflation.
- Increasing confidence.
- Increasing inventories.
- Rising short-term interest rates.
- Output gap is narrowing.
- Flat or rising bond yields.
- Rising stock prices.

Late Upswing

- Confidence and employment are high.
- Output gap eliminated and economy at risk of overheating.
- Inflation increases.
- Central bank limits the growth of the money supply.
- Rising short-term interest rates.
- Rising bond yields.
- Rising/peaking stock prices with increased risk and volatility.

Slowdown

- Duration of a few months to a year or longer.
- Declining confidence.
- Inflation is still rising.
- Falling inventory levels.
- Short-term interest rates are at a peak.
- Bond yields have peaked and may be falling, resulting in rising bond prices.
- Yield curve may invert.
- Falling stock prices.

Recession

- Duration of six months to a year.
- Large declines in inventory.
- Declining confidence and profits.
- Increase in unemployment and bankruptcies.
- Inflation tops out.
- Falling short-term interest rates.
- Falling bond yields, rising prices.
- Stock prices increase during the latter stages anticipating the end of the recession.

Inflation

Inflation means generally rising prices. For example, if the CPI index increases from 100 to 105, inflation is 5%. Inflation typically accelerates late in the business cycle (near the peak).

Disinflation means a deceleration in the rate of inflation. For example, if the CPI index then increases from 105 to 108, the rate of inflation decreases to approximately 3%.

Inflation typically decelerates as the economy approaches and enters recession.

Deflation means generally falling prices. For example, if the CPI index declines from 108 to 106, the rate of inflation is approximately –2%. Deflation is a severe threat to economic activity:

- It encourages default on debt obligations. Consider a homeowner who has a home worth $100,000 and a mortgage of $95,000; the homeowner's equity is only $5,000. A decline of more than 5% in home prices leads to negative equity and can trigger panic sales (further depressing prices), defaulting on the loan, or both.
- With negative inflation, interest rates decline to near zero and this limits the ability of central banks to lower interest rates and stimulate the economy. Following the financial crisis of 2007–09 and the resulting very low interest rates, several central banks tried a new monetary policy of **quantitative easing** (QE) to stimulate the economies of their countries. Traditionally, central banks have used open markets to increase the money supply and lower short-term interest rates on a temporary basis by buying high quality fixed-income instruments. QE was different in that it was larger in scale, the purchases included other security types such as mortgage-backed securities and corporate bonds, and the intent was a long-term increase in bank reserves, not temporary.

INFLATION AND ASSET RETURNS

LOS 16.g: Explain the relationship of inflation to the business cycle and the implications of inflation for cash, bonds, equity, and real estate returns.

CFA® Program Curriculum, Volume 3, page 58

The Business Cycle	Inflation	Economic Policy	Markets
Initial recovery	Initially declining inflation	Stimulative	ST rates low or declining LT rates bottoming and bond prices peaking Stock prices increasing
Early upswing	Low inflation and good economic growth	Becoming less stimulative	ST rates increasing LT rates bottoming or increasing with bond prices beginning to decline Stock prices increasing
Late upswing	Inflation rate increasing	Becoming restrictive	ST and LT rates increasing with bond prices declining Stock prices peaking and volatile
Slowdown	Inflation continues to accelerate	Becoming less restrictive	ST and LT rates peaking and then declining with bond prices starting to increase Stock prices declining

Recession	Real economic activity declining and inflation peaking	Easing	ST and LT rates declining with bond prices increasing Stock prices begin to increase later in the recession

Inflation and Relative Attractiveness of Asset Classes	
Inflation at or below expectations	Cash Equivalents (CE) and Bonds: Neutral with stable or declining yields Equity: Positive with predictable economic growth Real Estate (RE): Neutral with typical rates of return
Inflation above expectations	CE: Positive with increasing yields Bonds: Negative as rates increase and prices decline Equity: Negative, though some companies may be able to pass through inflation and do well RE: Positive as real asset values increase with inflation
Deflation	CE: Negative with approximately 0% interest rates Bonds: Positive as the fixed future cash flows have greater purchasing power (assuming no default on the bonds) Equity: Negative as economic activity and business declines RE: Negative as property values generally decline

PROFESSOR'S NOTE

Please note that these are generalizations that will not hold in every case. They are a good starting point for a forecaster taking a macro approach. Even if the generalizations always held, it is not easy to determine when a business cycle phase starts, how long it will last, or when it ends.

Consumer and Business Spending

As a percentage of GDP, consumer spending is much larger than business spending. Consumer spending is usually gauged through the use of store sales data, retail sales, and consumer consumption data. The data has a seasonal pattern, with sales increasing near holidays. In turn, the primary driver of consumer spending is consumer after-tax income, which in the United States is gauged using non-farm payroll data and new unemployment claims. Employment data is important to markets because it is usually quite timely.

Given that spending is income net of savings, savings data are also important for predicting consumer spending. Saving rates are influenced by consumer confidence and changes in the investment environment. Specifically, consumer confidence increases as the economy begins to recover from a recession, and consumers begin to spend more. At the same time, stock prices start to rise and momentum begins to build. Consumers continue spending until the economy shows definite signs that it has peaked (i.e., top of the business cycle) and reversed. At this point, consumers begin saving more and more until the economy “turns the corner,” and the cycle starts over.

Business spending is more volatile than consumer spending. Spending by businesses on inventory and investments is quite volatile over the business cycle. As mentioned before, the peak of inventory spending is often a bearish signal for the economy. It may indicate that businesses have overspent relative to the amount they are selling. This portends a slowdown in business spending and economic growth.

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MODULE QUIZ 16.3, 16.4

To best evaluate your performance, enter your quiz answers online.

1. Suppose an analyst is valuing two markets, A and B. What is the equity risk premium for the two markets, their expected returns, and the covariance between them, given the following?

Sharpe ratio of the global portfolio	0.29
Standard deviation of the global portfolio	8.0%
Risk-free rate of return	4.5%
Degree of market integration for Market A	80%
Degree of market integration for Market B	65%
Standard deviation of Market A	18%
Standard deviation of Market B	26%
Correlation of Market A with global portfolio	0.87
Correlation of Market B with global portfolio	0.63
Estimated illiquidity premium for Market A	0.0%
Estimated illiquidity premium for Market B	2.4%

2. Are there any attractive investments during deflationary periods?

3. An analyst notices that the growth of the national inventory-to-sales ratio has slowed after increasing for several years. **Identify** what this implies for this stage of the business cycle and for economic growth. **Explain** how a recent phenomenon has affected the ratio, independent of the business cycle.

4. The phase of the business cycle where we *most likely* expect to observe rising short-term interest rates and flat bond yields is:
   A. late expansion.
   B. initial recovery.
   C. early expansion.

MODULE 16.5: MONETARY POLICY AND INTEREST RATES

Monetary Policy

Video covering this content is available online.

Central banks often use monetary policy as a counter-cyclical force to optimize the economy's performance. Most central banks strive to balance price stability against economic growth. The ultimate goal is to keep growth near its long-run sustainable rate, because growth faster than the long-run rate usually results in increased inflation. As discussed previously, the latter stages of an economic expansion are often characterized by increased inflation. As a result, central banks usually resort to restrictive policies towards the latter part of an expansion.

To spur growth, a central bank can take actions to reduce short-term interest rates. This results in greater consumer spending, greater business spending, higher stock prices, and higher bond prices. Lower interest rates also usually result in a lower value of the domestic currency, which is thought to increase exports. In addition to the direction of a change in interest rates being important, it is also the level of interest rates that is important. If, for example, rates are increased to 4% to combat inflation but this is still low compared to the average of 6% in a country, then this absolute rate may still be low enough to allow growth while the rise in rates may begin to dampen inflation. The equilibrium interest rate in a country (the rate at which a balance between growth and inflation is achieved) is referred to as the neutral rate. It is generally thought that the neutral rate is composed of an inflation component and a real growth component. If, for example, inflation is targeted at 3% and the economy is expected to grow by 2%, then the neutral rate would be 5%.

LOS 16.h: Demonstrate the use of the Taylor rule to predict central bank behavior.

CFA® Program Curriculum, Volume 3, page 63

The neutral rate is the rate that most central banks strive to achieve as they attempt to balance the risks of inflation and recession. If inflation is too high, the central bank should increase short-term interest rates. If economic growth is too low, it should cut interest rates. The **Taylor rule** embodies this concept. Thus, it is used as a prescriptive tool (i.e., it states what the central bank should do). It also is fairly accurate at predicting central bank action.

> **For the Exam:** No excuses, this is a gift. The Taylor Rule is covered at all levels of the exam.

The Taylor rule determines the target interest rate using the neutral rate, expected GDP relative to its long-term trend, and expected inflation relative to its targeted amount. It can be formalized as follows:

$$r_{target} = r_{neutral} + [0.5(GDP_{expected} - GDP_{trend}) + 0.5(i_{expected} - i_{target})]$$

where:

r_{target} = short-term interest rate target

$r_{neutral}$ = neutral short-term interest rate

$GDP_{expected}$ = expected GDP growth rate

GDP_{trend} = long-term trend in the GDP growth rate

$i_{expected}$ = expected inflation rate

i_{target} = target inflation rate

EXAMPLE: Calculating the short-term interest rate target

Given the following information, **calculate** the short-term interest rate target.

Neutral rate	4%
Inflation target	3%
Expected inflation	7%
GDP long-term trend	2%
Expected GDP growth	0%

Answer:

$$\begin{aligned} r_{target} &= 4\% + [0.5\,(0\% - 2\%) + 0.5\,(7\% - 3\%)] \\ &= 4\% + (-1\% + 2\%) = 5\% \end{aligned}$$

> In this example, the weak projected economic growth calls for cutting interest rates. If inflation were not a consideration, the target interest rate would be 1% lower than the neutral rate. However, the higher projected inflation overrides the growth concern because projected inflation is 4% greater than the target inflation rate. In net, the target rate is 5% because the concern over high inflation overrides the weak growth concern.

Negative Interest Rates

Negative interest rates were generally considered a hypothetical curiosity before the 2007–2009 financial crises. A *negative rate* is defined as a net payment made to keep money on deposit at a financial institution or payment of a net fee to invest in short-term instruments.

Zero was regarded as the sustainable lower rate of interest because investors could hold physical cash instead (earning no interest). As investors withdrew funds from banks to hold cash, bank balance sheets would shrink as they paid out funds and stopped making loans. Simple supply and demand analysis should dictate that with a smaller supply of funds available to lend, the price paid (interest rate) to borrow increases.

The flaw in this analysis was that negative interest rates did not cause the expected large move into physical cash. The daily exchange of funds in modern economies is too large. The implicit advantages of being able to quickly transfer large amounts of money held on deposit to settle transactions outweighed the explicit cost of holding those deposits at negative rates. Without the exit of funds from the banking system, it turned out that negative interest rates were sustainable for extended periods.

As mentioned earlier, the slowdown in economic activity during the crisis and already very low interest rates led some central banks to experiment with less tested monetary policy—the quantitative easing (QE) approach. QE led to larger injections of funds by central banks into the commercial banking system with the announced intent that these injections were long term in nature. The hope was this would stimulate bank lending and increase economic activity. The negative interest rates should, in theory, have similar effects. Holders of funds would find it more desirable to spend the money, stimulating economic activity; or, they would invest in longer-term stocks and bonds, driving up prices and creating a wealth effect. Or, negative rates would lead consumers and businesses to borrow at zero or negative rates to spend now.

How these new policies actually end up working remains to be seen. For the policies to work, consumers, investors, and businesses have to believe the risk of spending now is worth it. Purchases and investments made now provide positive economic benefit in the future. But negative interest rates also signal uncertainty as to what the future holds.

Negative interest rates complicate the process of forming capital market expectations:

- The risk-free rate is the starting point for buildup models used to calculate expected *long-run* return for asset classes. When the risk-free rate is negative, a sustainable expected risk-free rate such as the policy neutral rate in the Taylor rule is more appropriate as that starting point. That rate is generally not regarded as fully risk free, so a modest default premium can be removed.
- Forming capital market expectation over shorter time horizons is further complicated by a need to forecast the time path over which negative rates will

converge to a long-run sustainable risk-free rate. Multiple path projections should be considered to allow for uncertainty regarding how the convergence will occur.

- Another approach to shorter-term projections of asset class returns is to interpret negative risk-free rates as being consistent with contraction or early recovery stages of the business cycle.
- Historical data to use as a starting point for any forecast is more problematic because few comparable periods exist, and the negative rates suggest significant structural economic changes are occurring. This kind of regime change makes statistics based on historical data less reliable, requiring more subjective assessments.
- Anticipating the effects of negative rates when combined with less tested QE makes forecasting even more challenging.

The bottom line is that we are in uncharted territory.

未知的，图上未标明的；

Fiscal Policy

Another tool at the government's disposal for managing the economy is fiscal policy. If the government wants to stimulate the economy, it can implement loose fiscal policy by decreasing taxes and/or increasing spending, thereby increasing the budget deficit. If they want to rein in growth, the government does the opposite to implement fiscal tightening.

There are two important aspects to fiscal policy. First, it is not the level of the budget deficit that matters—it is the change in the deficit. For example, a deficit by itself does not stimulate the economy, but increases in the deficit are required to stimulate the economy. Second, changes in the deficit that occur naturally over the course of the business cycle are not stimulative or restrictive. In an expanding economy, deficits will decline because tax receipts increase and disbursements to the unemployed decrease. The opposite occurs during a recession. Only changes in the deficit directed by government policy will influence growth.

THE YIELD CURVE

LOS 16.i: Interpret the shape of the yield curve as an economic predictor and discuss the relationship between the yield curve and fiscal and monetary policy.

CFA® Program Curriculum, Volume 3, page 67

The yield curve demonstrates the relationship between interest rates and the maturity of the debt security and is sensitive to actions of the federal government as well as current and expected economic conditions. When both fiscal and monetary policies are expansive, for example, the yield curve is sharply upward sloping (i.e., short-term rates are lower than long-term rates), and the economy is likely to expand in the future. When fiscal and monetary policies are restrictive, the yield curve is downward sloping (i.e., it is *inverted*, as short-term rates are higher than long-term rates), and the economy is likely to contract in the future.

Fiscal and monetary policies may reinforce or conflict each other. If the policies reinforce each other, the implications for the economy are clear. In all cases, there are likely implications for the yield curve:

- If both are stimulative, the yield curve is steep and the economy is likely to grow.
- If both are restrictive, the yield curve is inverted and the economy is likely to contract.
- If monetary is restrictive and fiscal is stimulative, the yield curve is flat and the implications for the economy are less clear.
- If monetary is stimulative and fiscal is restrictive, the yield curve is moderately steep and the implications for the economy are less clear.

MODULE QUIZ 16.5

To best evaluate your performance, enter your quiz answers online.

1. During an economic expansion, an analyst notices that the budget deficit has been declining. She concludes that the government's fiscal policy has shifted to a more restrictive posture. **Comment** on her conclusion.

2. **Calculate** the short-term interest rate target given the following information.

Neutral rate	5%
Inflation target	3%
Expected inflation	6%
GDP long-term trend	3%
Expected GDP	5%

3. A forecaster notes that the yield curve is steeply upwardly sloping. **Comment** on the likely monetary and fiscal policies in effect and the future of the economy.

MODULE 16.6: THE TREND RATE OF GROWTH

LOS 16.j: Identify and interpret the components of economic growth trends and demonstrate the application of economic growth trend analysis to the formulation of capital market expectations.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 68

The average growth rate over the economic cycle is limited by the long-term trend growth rate. That trend rate of growth is determined by basic economic factors:

- **Population growth and demographics** establish a limit to the growth rate of the labor force. Faster growth in population and increases in the participation rate (the percentage of population working) support faster long-term economic growth.
- **Business investment and productivity, a healthy banking system, and reasonable governmental policies** increase the growth rate of physical capital and productivity.
- Other factors or **shocks**—which are, by definition, unpredictable—may also affect the trend as well as the course of the business cycle. Examples have included war, major accounting scandals with resulting rule changes, and collapses in markets or currency value.

Overall, the trend rate of growth is relatively stable in developed economies. In emerging economies, that growth rate can be less predictable and include longer periods of rapid growth as those economies catch up with developed economies.

Longer term stability of the growth trend is related to stability in consumer spending, the largest component of both developed and emerging economies growth.

- The **wealth effect** suggests consumers spend more when wealth increases and less when it decreases. The wealth effect would contribute to swings between higher and lower spending and would amplify swings in the business cycle.
- However, the **permanent income hypothesis** asserts that consumer spending is mostly driven by long-run income expectations, not cyclical swings in wealth. This leads to countercyclical behavior, which dampens the business cycle. If income temporarily declines, consumers continue to spend (from savings) as long-term income expectations are more stable.

In summary, a basic model for forecasting trend economic growth focuses on:

- Growth in labor input based on growth in the labor force and labor participation.
- Growth in capital. Y=AK^aL^(1-a)
- Growth in total factor productivity.

EXAMPLE: Forecasting the long-term economic growth rate

Assume that the population is expected to grow by 2% and that labor force participation is expected to grow by 0.25%. If spending on new capital inputs is projected to grow at 2.5% and total factor productivity will grow by 0.5%, what is the long-term projected growth rate?

Answer:

The sum of the components equals 2% + 0.25% + 2.5% + 0.5% = 5.25%, so the economy is projected to grow by this amount.

PROFESSOR'S NOTE

The CFA text includes a similar example of summing factors to determine the long-term trend rate of growth. The Cobb-Douglas function later refines this as a more sophisticated weighted average calculation. If the data is available for Cobb-Douglas, that should be used; otherwise, the simple addition is all you can do.

Implications of the Growth Trend for Capital Markets

- High rates of growth in capital investment are associated with high rates of growth in the economy.
- However, these high growth rates are not necessarily linked to favorable equity returns as equity return is related to the rate of return on capital. For example, if the rate of growth of capital is faster than the rate of economic growth, return on capital and equity returns may be less attractive.

Structural (consistent, as opposed to one-time) government policies that can facilitate long-term growth are:

1. **Sound fiscal policy.** While counter-cyclical fiscal policy to 抑制 dampen the business cyclical is acceptable, persistent large government budget deficits are detrimental. The government deficit is often associated with a current account deficit (caused primarily when imports exceed exports).

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   借钱进口

   1.外资撤离 =》本币贬值

   2.印钱 =》通胀 挤出效应

   The association between the government budget and current account deficits is called the twin deficit problem. The government deficit may be financed with excessive borrowing in the foreign markets. This borrowing in foreign (rather than domestic) markets finances the ability to import more than is exported and supports higher but unsustainable economic growth. There are several potential outcomes. The excessive borrowing can stop, leading to a substantial cutback in spending by the government and consumers. The currency can devalue when foreign investors are no longer willing to hold the debt. Alternatively, the government deficit can be financed with printing money (which leads to high inflation) or with excessive domestic borrowing by the government (which crowds out businesses borrowing to finance business investment). All of the outcomes are detrimental to continuing real growth.

2. **Minimal government interference with free markets.** Labor market rules that increase the structural level of unemployment are particularly detrimental.
3. **Facilitate competition in the private sector.** Policies to enable free trade and capital flows are particularly beneficial.
4. **Development of infrastructure and human capital**, including education and health care.

5. **Sound tax policies.** Understandable, transparent tax rules, with lower marginal tax rates applied to a broad tax base.

LOS 16.k: Explain how exogenous shocks may affect economic growth trends.

CFA® Program Curriculum, Volume 3, page 74

In addition to being influenced by governmental policies, trends are still subject to unexpected surprises or shocks that are exogenous to the economy, and many shocks and the degree of their impact on capital markets cannot be forecasted. For example, turmoil in the Middle East may change the long-term trend for oil prices, inflation, and economic growth in the developed world. Shocks may also arise through the banking system. An extreme example is the U.S. banking crisis of the 1930s, when a severe slowdown in bank lending paralyzed the economy.

Exogenous shocks are unanticipated events that occur outside the normal course of an economy. Since the events are unanticipated, they are not already built into current market prices, whereas normal trends in an economy, which would be considered endogenous, are built into market prices. Exogenous shocks can be caused by different factors, such as natural disasters, political events, or changes in government policies.

Although positive shocks are not unknown, exogenous shocks usually produce a negative impact on an economy and oftentimes spread to other countries in a process referred to as *contagion*. Two common shocks relate to changes in oil supplies and crises in financial markets. Oil shocks have historically involved increasing prices caused by a reduction in oil production. The increased oil prices can lead to increased inflation and a subsequent slowdown of the economy from decreased consumer spending and increased unemployment. Conversely, a decline in oil prices, as was the case in 1986 and 1999, can produce lower inflation, which boosts the economy. A significant decline in oil prices, however, can lead to an overheated economy and increasing inflation.

Financial crises are also not uncommon. Consider the Latin America debt crisis in the early 1980s, the devaluation of the Mexican peso in 1994, the Asian and Russian financial crises of the late 1990s, and most recently, the worldwide decline in property values. Banks are usually vulnerable in a financial crisis, so the central bank steps in to provide financial support by increasing the amount of money in circulation to reduce interest rates. This is difficult to do, however, in an already low inflation, low interest rate environment and especially in a deflationary environment.

MODULE QUIZ 16.6

To best evaluate your performance, enter your quiz answers online.

1. An analyst would like to project the long-term growth of the economy. Which of the following would you recommend he focus on: changes in consumer spending or potential changes in tax policy due to a new government coming into office?

2. An analyst is evaluating an emerging market for potential investment. She notices that the country's current account deficit has been growing. Is this a sign of increasing risk? If so, **explain** why.

MODULE 16.7: INTERNATIONAL CONSIDERATIONS

LOS 16.l: Identify and interpret macroeconomic, interest rate, and exchange rate linkages between economies.

CFA® Program Curriculum, Volume 3, page 75

Video covering this content is available online.

Economic links between countries have become increasingly important with globalization, especially for small countries with undiversified economies. Larger countries with diverse economies, such as the United States, are less affected but are still influenced by globalization.

Macroeconomic links can produce convergence in business cycles between two economies. International trade produces one such link, as a country's exports and economy are depressed by a slowdown in a trading partner's economy and level of imports. International capital flows produce another link if cross-border capital investing by a trading partner declines as its economy contracts.

Interest rates and **currency exchange rates** can also create linkages. A strong link is created when a smaller economy "pegs" its currency to that of a larger and more developed economy. The peg is a unilateral declaration by the pegging country to maintain the exchange rate. In general, the linkage between the business cycles of the two economies will increase, as the pegged currency country must follow the economic policies of the country to which it has pegged its currency. If not, investors will favor one currency over the other and the peg will fail.

Generally, the interest rates of the pegged currency will exceed the interest rates of the currency to which it is linked, and the interest rate differential will fluctuate with the market's confidence in the peg. If confidence is high, the rate differential can be small. If there is doubt the peg will be maintained, investors will require a larger interest rate differential as compensation for the risk of holding the pegged currency. A common problem arises if investors begin to lose confidence in the pegged currency and it begins to decline in value. The pegging country must then increase short-term interest rates to attract capital and maintain the value of the currency at the peg.

Pegs have become less common following the 1997 Asian financial crises. In the absence of pegging, the relationship of interest rate differentials and currency movement can reflect several factors:

- If a currency is substantially overvalued and expected to decline, bond interest rates are likely to be higher to compensate foreign investors for the expected decline in the currency value.

- Relative bond yields, both nominal and real, increase with strong economic activity and increasing demand for funds.

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- One economic theory postulates that differences in nominal interest rates are a reflection of differences in inflation and that real interest rates are equal. However, real rates actually differ substantially, though there is a tendency for the overall level of real rates among countries to move up and down together.

PROFESSOR'S NOTE

The relationship between currency values and interest rates is complicated. You may recall a theory from earlier levels that if real interest rates are equal and the movement of currency value consistently reflects the difference in inflation rates, then the forward exchange rate is a good predictor of what will happen in the currency market. The Level III material will not support those assumptions and does not support the use of the forward exchange rate as a predictor of what will happen. This is addressed in multiple study sessions.

EMERGING MARKET ECONOMIES

LOS 16.m: Discuss the risks faced by investors in emerging-market securities and the country risk analysis techniques used to evaluate emerging market economies.

CFA® Program Curriculum, Volume 3, page 77

Emerging markets offer the investor high returns at the expense of higher risk. Many emerging markets require a heavy investment in physical and human (e.g., education) infrastructure. To finance this infrastructure, many emerging countries are dependent on foreign borrowing, which can later create crisis situations in their economy, currency, and financial markets.

Many emerging countries also have unstable political and social systems. The lack of a middle class in these countries does not provide the constituency for needed structural reforms. These small economies are often heavily dependent on the sale of commodities, and their undiversified nature makes them susceptible to volatile capital flows and economic crises.

The investor must carefully analyze the risk in these countries. For the bond investor, the primary risk is credit risk—does the country have the capacity and willingness to pay back its debt? For equity investors, the focus is on growth prospects and risk. There are six questions potential investors should ask themselves before committing funds to these markets.

1. **Does the country have responsible fiscal and monetary policies?** To gauge fiscal policy, most analysts examine the deficit to GDP ratio. Ratios greater than
deficit/gdp<4%
4% indicate substantial credit risk. Most emerging counties borrow short term and must refinance on a periodic basis. A buildup of debt increases the likelihood that
debt/gdp<70%
the country will not be able to make its payments. Debt levels of 70 to 80% of GDP have been troublesome for developing countries.
2. **What is the expected growth?** To compensate for the higher risk in these countries, investors should expect a growth rate of at least 4%. Growth rates less than that may indicate that the economy is growing slower than the population,

which can be problematic in these underdeveloped countries. The structure of an economy and government regulation is important for growth. Tariffs, tax policies, and regulation of foreign investment are all important factors for growth.

3. **Can the country maintain a stable, appropriate currency value?** Swings between over- and under-valuation are detrimental to business confidence and investment. Prolonged over-valuation promotes external borrowing, artificially stimulating the economy and imports (leading to a current account deficit and the twin deficit problem). However, the foreign debt must be serviced (interest paid and principal rolled over). A current account deficit exceeding 4% of GDP has been a warning sign of potential difficulty.
4. **Is the country too highly leveraged?** Although emerging countries are dependent on foreign financing for growth, too much debt can eventually lead to a financial crisis if foreign capital flees the country. These financial crises are accompanied by currency devaluations and declines in emerging market asset values. Foreign debt levels greater than 50% of GDP indicate that the country may be overleveraged. Debt levels greater than 200% of the current account receipts also indicate high risk.
5. **What is the level of foreign exchange reserves relative to short-term debt?** Foreign exchange is important because many emerging country loans must be paid back in a foreign currency. The investor should be wary of countries where the foreign exchange reserves are less than the foreign debt that must be paid off within one year.
6. **What is the government's stance regarding structural reform?** If the government is supportive of structural reforms necessary for growth, then the investment environment is more hospitable. When the government is committed to responsible fiscal policies, competition, and the privatization of state-owned businesses, there are better prospects for growth.

MODULE 16.8: MARKET FORECASTING

LOS 16.n: Compare the major approaches to economic forecasting.

CFA® Program Curriculum, Volume 3, page 80

Video covering this content is available online.

1. **Econometric analysis** uses economic theory to formulate the forecasting model. The models can be quite simple to very complex, involving several or hundreds of relationships. For example, the analyst may want to forecast GDP using current and lagged consumption and investment values. Ordinary least squares regression is most often used, but other statistical methods are also used to develop these models.

Advantages:

- Modeling can incorporate many variables.
- Once the model is specified, it can be reused.

- Output is quantified and based on a consistent set of relationships.

Disadvantages:

- Models are complex and time-consuming to construct.
- The data may be difficult to forecast and the relationships can change.
- Output may require interpretation or be unrealistic.
- Does not work well to forecast recessions.

2. **Economic indicators** are available from governments, international organizations (e.g., the Organization of Economic Cooperation and Development), and private organizations (e.g., the Conference Board in the United States).

Many analysts use a combination of publically available indicators and their own proprietary indicators. The most useful indicators are **leading indicators** that move ahead of the business cycle with a reasonable stable lead time. These can be used to predict what will happen next. The leading indicators can be used individually or as a **composite**. For example, the Conference Board provides 10 leading indicators for the United States, which can be combined into an index. Traditionally, three consecutive months of increase (decrease) for the index are expected to signal the start of an economic expansion (contraction) within a few months. A composite can also be referred to as a 扩散 **diffusion index** and used to measure the number of indicators pointing towards expansion versus contraction in the economy.

There are also **coincident** and **lagging indicators** that move with and after changes in the business cycle. These can be used to confirm what is happening in the economy.

Advantages:

- Economic indicators are simple, intuitive, and easy to interpret.
- The data is often readily available from third parties.
- Indicator lists can be tailored to meet specific forecasting needs.
- Academic literature supports the approach.

Disadvantages:

- Forecasting results have been inconsistent.
- Economic indicators have given false signals.

3. A **checklist approach** can incorporate elements of the above but is more subjective. In this approach, an analyst considers a series of questions. For example, to forecast GDP, the analyst may consider, “What was the latest employment report? What is the central bank’s next move, given the latest information released? What is the latest report on business investment?” Then, the analyst uses judgement to interpret the answers and

formulate a forecast. Judgement is required both in determining what factors to consider and how to interpret them.

Advantages:

- Less complex than econometrics.
- Flexible in mixing objective statistical analysis with judgement to incorporate changing relationships.

Disadvantages:

- Subjective.
- Time–consuming.
- Complexity must be limited because it is a manual process.

ECONOMIC CONDITIONS AND ASSET CLASS RETURNS

LOS 16.o: Demonstrate the use of economic information in forecasting asset class returns.

LOS 16.p: Explain how economic and competitive factors can affect investment markets, sectors, and specific securities.

CFA® Program Curriculum, Volume 3, pages 88 and 93

Investors ultimately use capital market expectations to form their beliefs about the attractiveness of different investments. This is one of the primary steps in top-down analysis. We next examine how economic information can be used in forecasting asset class returns. We start with cash.

Cash Instruments

Cash typically refers to short-term debt (e.g., commercial paper) with a maturity of one year or less. Cash managers adjust the maturity and creditworthiness of their cash investments depending on their forecasts for interest rates and the economy. If, for example, a manager thinks interest rates are set to rise, he will shift from 9-month cash instruments down to 3-month cash instruments. If he thinks the economy is going to improve, so that less creditworthy instruments have less chance of default, he will shift more assets into lower-rated cash instruments. Longer maturity and less creditworthy instruments have higher expected return but also more risk.

The interest rate for overnight loans among U.S. banks is the Federal Funds rate and is set by the Federal Reserve through its purchases and sales of government debt. This rate is fairly stable except during periods of unusual market volatility. In the European Union, the European Central Bank targets the repo rate.

The yield for debt securities of various maturities reflects the market's anticipation of yields over future periods. To earn excess returns, the manager must be able to forecast future rates better than other managers, and this in part requires anticipation of what the central bank will do in the future.

Credit Risk-Free Bonds

The most common type of credit risk-free bonds are those issued by governments in developed countries. The yield on these bonds is composed of a real yield and the expected inflation over the investment horizon. If, for example, the investor thinks that inflation will be 2% over the life of the bond and the investor requires a real return of 4%, then the investor would only purchase the bond if its yield were 6% or more. Based on historical data, the real yield on an ex ante basis should be roughly 2–4%.

The investor with a short time horizon will focus on cyclical changes in the economy and changes in short-term interest rates. Higher expected economic growth results in higher yields because of anticipated greater demand for loanable funds and possibly higher inflation. A change in short-term rates, however, has less predictable effects. Usually an increase in short-term rates increases the yields on medium- and long-term bonds. Medium- and long-term bond yields may actually fall, though, if the interest rate increase is gauged sufficient to slow the economy.

Over the past 40 years, the inflation premium embedded in bonds has varied quite a bit in developed countries. In the 1960s, it was quite low but rose in the late 1970s as investors became accustomed to higher inflation. More recently, it has dropped as inflation has been low.

Credit Risky Bonds

The most common type of credit risky bonds are corporate bonds. To estimate the credit risk premium assigned to individual bonds, the analyst could subtract the yield of Treasuries from that of corporate bonds of the same maturity to calculate the spread. During a recession, the credit risk premium, or spread, increases because default becomes more likely. At the same time, the credit offered by banks and the commercial paper market also dries up so that corporations have to offer higher yields to attract investors. More favorable economic conditions result in lower credit risk premiums.

Emerging Market Government Bonds

The key difference between developed country government bonds and emerging market government bonds is that most emerging debt is denominated in a non-domestic currency. Emerging market bonds are usually denominated in a hard currency (e.g., dollars, euros); thus, the emerging market government must obtain the hard currency to pay back the principal and interest. The default risk for emerging market debt is appropriately higher. To assess this risk, analysts use country risk analysis, which focuses on the economic and political environment in a country (as discussed previously for emerging markets).

Inflation-Indexed Bonds

Several governments issue bonds that adjust for inflation so that the investor is protected against it. An example is U.S. Treasury Inflation Protected Securities (TIPS). These bonds are both credit risk and inflation risk free. But they are not free of price risk. Their prices and yields still vary as economic conditions change and as the supply and demand for these instruments vary. The yield on these bonds has been correlated with three economic factors. Their yield:

- Rises (falls) as the real economy expands (contracts). This is primarily because their yield is tracking short-term interest rates, which also move with the economy.
- Falls as inflation accelerates and more investors seek to buy the inflation-index bonds. The increase in demand leads to higher prices and lower yields.
- Changes with supply and demand. These markets are somewhat small, making supply and demand changes more important.

Common Stock

To understand how economic conditions affect stock values, recall that the value of an asset is the present value of its future cash flows. For stocks, both the cash flows (earnings) and discount rate (risk-adjusted required return) are important. Earnings are commonly used to value the stock market because they should be reflected in both the cash paid out as dividends and as capital gains. Aggregate earnings depend primarily on the trended rate of growth in an economy, which in turn depends on labor force growth, new capital inputs, and total factor productivity growth.

As discussed earlier, when the government promotes competition in the marketplace, this increases the efficiency of the economy and should lead to higher long-term growth in the economy and the stock market. Of course, an investor would prefer an individual stock to have a monopolistic, noncompetitive position in their product market. This, however, would not be healthy for the growth of the overall stock market.

Shorter-term growth is affected by the business cycle. In a recession, sales and earnings decrease. Noncyclical or defensive stocks (e.g., utilities) are less affected by the business cycle and will have lower risk premiums and higher valuations than cyclical stocks (e.g., technology firms). Cyclical stocks are characterized by high business risk (sensitivity to the business cycle) and/or high fixed costs (operating leverage).

Recall that in the early expansion phase of the business cycle, stock prices are generally increasing. This is because sales are increasing, but input costs are fairly stable. For example, labor does not ask for wage increases because unemployment is still high, and idle plant and equipment can be pushed into service at little cost. Furthermore, firms usually emerge from a recession leaner because they have shed their wasteful projects and excessive spending. Later on in the expansion, earnings growth slows because input costs start to increase. As mentioned earlier, interest rates will also increase during late expansion, which is a further negative for stock valuation.

A stock’s valuation in the market is reflected in its price-earnings (P/E) ratio. P/E ratios are higher in an early expansion period when interest rates are low and earnings prospects are high. They decline as earnings prospects decline. Note that for cyclical stocks, P/E ratios may be quite high in a recession, if investors are anticipating that the economy will soon recover. P/E ratios are also affected by long-term trends. For example, the 1990s was thought to be a new era of productivity, earnings growth, low inflation, and low interest rates. P/E ratios were abnormally high during this time period. Low inflation results in high P/E ratios because earnings are more *real* and less subject to interpretation.

Emerging Market Stocks

Historical returns for emerging market stocks are higher and more variable than those in the developed world and seem to be positively correlated with business cycles in the developed world. This correlation is due to trade flows and capital flows. In addition, emerging countries share many of the same sectors as those in the developed world. The analyst should have a good understanding of country and sector patterns when valuing emerging market stocks.

Real Estate

Real estate assets are affected by interest rates, inflation, the shape of the yield curve, and consumption. Interest rates affect both the supply of, and demand for, properties through mortgage financing rates. They also determine the capitalization rate (i.e., discount rate) used to value cash flows.

MODULE QUIZ 16.7, 16.8

To best evaluate your performance, enter your quiz answers online.

1. An analyst is evaluating two countries. Maldavia has a GDP of $60 billion and an economy that is dominated by the mining industry. Oceania has a GDP of $1.2 trillion and an economy that sells a variety of items. He is predicting a global economic slowdown. Which country is at greater risk?

2. An analyst believes that GDP is best forecast using a system of equations that can capture the fact that GDP is a function of many variables, both current and lagged values. Which economic forecasting method is she *most likely* to use?

3. At a conference, Larry Timmons states that a pegged exchange rate allows a less developed country to achieve greater currency and economic stability, as well as relatively lower and more stable interest rates, and to pursue the fiscal and economic policies to maximize the country's real economic growth. **Explain** what is correct and incorrect in Timmons's statement.

MODULE 16.9: EXCHANGE RATE FORECASTING

LOS 16.q: Discuss the relative advantages and limitations of the major approaches to forecasting exchange rates.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 100

The value of a currency is determined by its supply and demand, which in turn is affected by trade flows and capital flows. For example, if the United States has a trade deficit with Japan (i.e., it imports more from Japan than it exports to Japan), the value of the dollar should decline against the yen. The reason is that to obtain the foreign good, U.S. consumers are essentially selling their dollars to obtain yen.

In regard to capital flows, if U.S. Treasury bonds are in high demand due to their safety and attractive return, foreign investors will sell their currency in order to obtain dollars. The value of the foreign currency will fall while the value of the dollar will rise. Capital will flow into a country when capital restrictions are reduced, when an economy's strong growth attracts new capital, or when interest rates are attractive. Higher interest rates generally attract capital and increase the domestic currency value. At some level, though, higher interest rates will result in lower currency values because the high rates may 遏制 stifle an economy and make it less attractive to invest there.

The emphasis on international diversification has increased capital flows. Capital flows can be volatile but are less so if the capital is invested in real assets through foreign direct investment. Currency values can also become volatile when a country is forced to abandon a pegged value targeted by its government.

The volatility in currency values makes them difficult to forecast but presents both risks and rewards for portfolio managers. We examine four methods of forecasting exchange rates: (1) relative purchasing power parity, (2) relative economic strength, (3) capital flows, and (4) savings and investment imbalances.

The first method is the relative form of **purchasing power parity** (PPP). PPP states that differences in inflation between two countries will be reflected in changes in the exchange rate between them. Specifically, the country with higher inflation will see its currency value decline. For example, assume Japanese inflation is projected to be a cumulative 8.2% over the next five years, while U.S. inflation is 13.2% over the same period. U.S. inflation is thus projected to be 5% higher. If the current exchange rate is ¥100/\$, then the projected exchange rate is approximately ¥100/\$ × (1 − 0.05) = ¥95/\$ (note that the dollar has depreciated here because it buys five less yen).

PPP does not hold in the short term or medium term but holds approximately in the long term (five years or more). PPP is given attention by governments and forecasters, but its influence on exchange rates may be 淹没 swamped by other factors, such as trade deficits.

The second method of forecasting currency values is the **relative economic strength approach**. The idea behind this approach is that a favorable investment climate will attract investors, which will increase the demand for the domestic currency and increase the currency's value. Investors would be attracted by strong economic growth in a country. Alternatively, high short-term interest rates may also attract investors. High short-term interest rates will attract investors who buy the currency in order to invest the currency at those high short-term rates. Interestingly, even if the general consensus is the currency is overvalued based on fundamentals, high rates may still attract attention and keep the currency overvalued or cause further appreciation in the short-run. The relative economic strength approach may be better suited to forecasting short-run changes in currency value.

The third approach to forecasting exchange rates is the **capital flows approach**. This approach focuses primarily on long-term capital flows, such as those into equity investments or foreign direct investments. For example, the strength of the U.S. dollar in the later 1990s was thought to be due to the strength of the U.S. stock market.

短期降息
-》刺激
-》长期看好
-》资本流入
-》升值

The flow of long-term funds complicates the relationship between short-term rates and currency values as discussed in the relative strength approach. For example, a cut in U.S. short-term rates may actually strengthen the dollar because the cut might promote U.S. growth and the attractiveness of U.S. stocks. This makes the central bank's job more difficult. If the Federal Reserve wanted to boost short-term rates to increase the value of the dollar and tame inflation, their action may actually result in a decline in the value of the dollar as investors find U.S. capital assets less attractive.

The last approach is the **savings-investment imbalances approach**. This approach is not readily implemented for forecasting but explains why currencies may diverge from equilibrium values for extended periods. This approach starts with the concept that an economy must fund investment through savings. If investment is greater than domestic savings, then capital must flow into the country from abroad to finance the investment. A savings deficit can be attributable to both the government and private sector.

投资来于储蓄
储蓄不足
靠引外资
须高汇率&
经常账户赤字

In order to attract and keep the capital necessary to compensate for the savings deficit, the domestic currency must increase in value and stay strong (perhaps as a result of high interest rates or economic growth). At the same time, the country will have a current account deficit where exports are less than imports. Although a current account deficit would normally indicate that the currency will weaken, the currency must stay strong to attract foreign capital.

The aforementioned scenario typically occurs during an economic expansion when businesses are optimistic and use their savings to make investments. Eventually, though, the economy slows, investment slows, and domestic savings increase. It is at this point that the currency will decline in value.

In addition to the four approaches described previously, one could also examine government intervention to determine the future path of exchange rates. This approach is not very fruitful, though, because most observers don't think governments can exert much control over exchange rates. The reason is that government trading is too small in volume to affect the massive currency markets. Furthermore, currencies are more influenced by economic fundamentals than by periodic trading by governments.

MODULE 16.10: COMPREHENSIVE EXAMPLE

Video covering this content is available online.

LOS 16.r: Recommend and justify changes in the component weights of a global investment portfolio based on trends and

expected changes in macroeconomic factors.

CFA® Program Curriculum, Volume 3, page 88

For the Exam: This LOS asks you to use much of what you have learned here and apply it to portfolio management. Given that the emphasis of the Level III exam is portfolio management, you need to be able to pull all this material together.

EXAMPLE: Applying capital market expectations

A portfolio manager has a global portfolio invested in several countries and is considering other countries as well. The decisions the manager faces and the economic conditions in the countries are described in the following. In each case, the portfolio manager must reallocate assets based on economic conditions.

Decision #1: Reallocation to Country A

The portfolio manager has noticed that the yield curve is downward sloping in this country. The current portfolio in this country is 60% stocks and 40% bonds. Suggest changes to the portfolio based on this information.

Decision #2: Allocation to Country B

Country B has experienced declining prices and this trend is expected to continue. The manager has no funds invested in this country yet but is considering investments in bonds, equity, and real estate. In which assets should the manager invest?

Decision #3: Allocations to Emerging Country C or Country D

The manager is considering the purchase of government bonds in either emerging Country C or D.

The countries have the following characteristics:

Characteristics of Countries C and D

	Country C	**Country D**
Foreign exchange/Short-term debt	147%	78%
Debt to GDP	42%	84%

Decision #4: Country, Asset, and Currency Allocations

The manager will make a long-term investment in either Country E or F, based on projections of each economy's trended growth rate. Given that decision, the manager will then decide whether to invest in stocks or bonds. Lastly, the manager will use the savings-investment imbalances approach to gauge the strength of the currencies. The countries have the following characteristics:

Characteristics of Countries E and F

	Country E	**Country F**
Population growth	2.5%	2.0%
Labor force participation growth	0.2%	0.9%
Growth in spending on new capital inputs	1.5%	2.2%
Growth in total factor productivity	0.4%	0.8%

Expected savings relative to investment	Surplus	Deficit

Answers:

Decision #1: Reallocation to Country A

The downward sloping yield curve indicates that the economy is likely to contract in the future. In recessions, bonds outperform stocks because inflation and interest rates decrease and economic growth is slow. Assuming the accuracy of the yield curve forecast and that interest rates will fall further, the portfolio manager should consider reallocating from stocks into bonds.

Decision #2: Allocation to Country B

The manager should invest in bonds. In periods of declining prices or deflation, bonds perform well because there is no inflation and interest rates are declining. Stocks usually perform poorly during deflationary periods because economic growth is slowing. Real estate also performs poorly during deflationary times, particularly when the investment is financed with debt.

Decision #3: Allocations to Emerging Country C or Country D

The manager should purchase the bonds of Country C. Many emerging market bonds are denominated in a hard currency, so less risky countries have greater foreign currency reserves. Low levels of leverage are also preferred. One measure of leverage is the debt to GDP ratio.

Decision #4: Country, Asset, and Currency Allocations

To forecast the long-term economic growth rate, we sum population growth, labor force participation growth, growth in spending on new capital inputs, and growth in total factor productivity.

In Country E, it is 2.5% + 0.2% + 1.5% + 0.4% = 4.6%.

In Country F, it is 2.0% + 0.9% + 2.2% + 0.8% = 5.9%.

Country F has the higher trended growth rate, so the manager should invest there. The growth rate of 5.9% is quite attractive, and given that the manager is investing for the long term, the investment should be made in equities because equities will benefit the most from this high growth rate. Bond returns are based more on expectations of interest rates and inflation. A high growth economy may experience higher inflation and interest rates at some point that would be negative for bonds.

In the absence of other information, we would surmise from the savings-investment imbalances approach that Country E's currency will depreciate because the country has a savings surplus. Foreign capital will not be needed and, hence, Country E does not require a high currency value. Country F's currency will appreciate because the savings deficit will require a strong currency to attract foreign capital.

For the Exam: In sum, you need to be able to determine the relevant inputs to economic forecasts and what the forecasted economic conditions mean for asset values. Also, be ready to use the forecasting tools discussed earlier and identify problems in forecasting.

MODULE QUIZ 16.9, 16.10

To best evaluate your performance, enter your quiz answers online.

1. Suppose the United States has a persistent current account deficit. Which of the following approaches to forecasting currencies *best* explains why the U.S. dollar will be strong during this time period?
   A. The capital flows approach.
   B. The relative economic strength approach.
   C. The savings-investment imbalances approach

2. Suppose the United States has higher inflation than Japan. The United States is in the late expansion phase of the business cycle and Japan is in the initial recovery phase. Using only the PPP relationship for forecasting currency values and using the relationship between asset class returns and the business cycle, which asset should the manager invest in?
   A. U.S. bonds.
   B. Japanese bonds.
   C. Japanese stocks

KEY CONCEPTS

LOS 16.a

Capital market expectations (macro expectations) help in formulating the strategic asset allocation. They can also assist in detecting short-term asset mispricing exploitable through tactical asset allocation. Formulating capital market expectations is referred to as beta research because it is related to systematic risk.

To formulate capital market expectations, use the following process:

- Determine the relevant capital market expectations given the investor's tax status, allowable asset classes, and time horizon.
- Investigate assets' historical performance as well as the determinants of their performance.
- Identify the valuation model used and its requirements.
- Collect the best data possible.
- Use experience and judgment to interpret current investment conditions.
- Formulate capital market expectations.
- Monitor performance and use it to refine the process.

LOS 16.b

Limitations in the use of economic data for forecasting include the following:

- Data is reported with a lag, subject to revision, and defined inconsistently in different countries.
- Data is subject to biases and errors such as transcription errors, survivorship bias, and smoothed (appraised) data estimates.
- Using historical data is less appropriate when economic conditions change (regime change and nonstationary issues).
- Ex post risk generally understates ex ante risk, as surviving the past does not guarantee the future cannot be worse.
- Analyst bias in selective data mining or selection of time periods to examine.
- Failure to condition information for the likely state of the economy.
- Misinterpreting correlation with causation. Does A cause B, does B cause A, or are both just associated with some other factor C?
- Psychological traps related to cognitive errors and emotional biases.
- Errors in selecting the wrong model or inputs.

LOS 16.c

Statistical tools include:

- Using historical data to develop descriptive statistics.

- Applying shrinkage estimates to weight historically based estimates with model-based estimates.
- Using time series models to estimate variance.
- Using a single data set and multifactor models to generate internally consistent estimates of return, risk, and covariances between asset classes.

Discounted cash flow models include:

- Grinold-Kroner to estimate equity market return.
- YTM for bond return.

Buildup models of "risk-free" plus risk premiums for bond and equity return.

Financial equilibrium models (Singer-Terhaar) based on the world market Sharpe ratio, the individual market's standard deviation, and degree of integration; plus any non-systematic risk premiums.

LOS 16.d

Capital market expectations can also be formed using surveys. In this method, a poll is taken of market participants (e.g., economists and analysts) to determine what their expectations are regarding the economy or capital market. If the group polled is constant over time, this method is referred to as a panel method.

Surveys have been taken regarding the equity risk premium, with investors expecting a premium in the range of 2% to 3.9%. Other studies have found that the expectations of practitioners are consistently more optimistic than that of academics.

Judgment can also be applied to project capital market expectations. Although quantitative models provide objective numerical forecasts, there are times when an analyst must adjust those expectations using her experience and insight to improve upon those forecasts.

LOS 16.e

Understanding the business cycle can help the analyst identify inflection points where the risk and opportunities for higher return may be heightened. To identify inflection points, the analyst should understand what is driving the current economy and what may cause the end of the current economy.

The inventory cycle is often measured using the inventory to sales ratio. The measure increases when businesses gain confidence in the future of the economy and add to their inventories in anticipation of increasing demand for their output. As a result, employment increases with subsequent increases in economic growth. This continues until some precipitating factor, such as a tightening in the growth of the money supply, intervenes. At this point, inventories decrease, employment declines, and economic growth slows.

LOS 16.f

The relationship between the business cycle and assets returns is well documented. Assets with higher returns during business cycle lows (e.g., bonds and defensive stocks) should be favored by investors because the return supplements their income during recessionary periods—these assets should have lower risk premiums. Assets with lower returns during recessions should have higher risk premiums. Understanding the relationship between an asset's return and the business cycle can help the analyst provide better valuations.

LOS 16.g

Inflation varies over the business cycle, rising in the latter stages of an expansion and falling during a recession and the initial recovery.

Deflation reduces the value of investments financed with debt (e.g., real estate) because leverage magnifies losses.

Bond prices will rise during a recession when inflation and interest rates are declining. In a strong expansion, bonds tend to decline in price as inflationary expectations and interest rates rise.

Equities provide an inflation hedge when inflation is moderate. High inflation can be problematic because slow growth may result from central bank action. Declining inflation or deflation is harmful because this can result in declining economic growth.

Increasing inflation is positive for cash instruments because the returns on cash instruments increase as inflation increases. Deflation is negative for cash because the return falls to zero.

LOS 16.h

The Taylor rule:

$$r_{target} = r_{neutral} + [0.5(GDP_{expected} - GDP_{trend}) + 0.5(i_{expected} - i_{target})]$$

- A central bank can use the Taylor rule to determine the appropriate level for short-term interest rates.
- An investment strategist who expects unanticipated changes in the inputs to the Taylor rule can use the rule to anticipate changes in short-term interest rates by the central bank.

LOS 16.i

The yield curve demonstrates the relationship between interest rates and the maturity of the debt security and is sensitive to actions of the federal government as well as current and expected economic conditions. For example, when both fiscal and monetary policies are expansive, the yield curve is sharply upward sloping, which indicates that the economy is likely to expand in the future. When fiscal and monetary policies are restrictive, the yield curve is downward sloping, indicating that the economy is likely to contract in the future.

When fiscal and monetary policies are in disagreement, the shape of the yield curve is less definitively shaped. Recall that monetary policy controls primarily short-term interest rates. If monetary policy is expansive while fiscal policy is restrictive, the yield curve will be upward sloping, though it will be less steep than when both policies are expansive. If monetary policy is restrictive while fiscal policy is expansive, the yield curve will be more or less flat.

LOS 16.j

In forecasting a country's long-term economic growth trend, the trend growth rate can be decomposed into two main components and their respective subcomponents:

1. Changes in employment levels.
    - Population growth.
    - Rate of labor force participation.
2. Changes in productivity.
    - Spending on new capital inputs.
    - Total factor productivity growth.

LOS 16.k

Exogenous shocks are unanticipated events that occur outside the normal course of an economy and have a negative impact upon it. They can be caused by different factors, such as natural disasters, political events, or changes in government policies. Typically, two types of shocks have occurred, which are oil shocks and financial crises. Oil shocks are usually caused by crises in the Middle East followed by decreased oil production, leading to increasing prices, inflation, reduced consumer spending, higher unemployment, and a slowed economy. The opposite shock would be a decline in oil prices, leading to lower inflation and boosting the economy. Financial crises have occurred when countries can't meet their debt payments, currencies are devalued, and property values have declined. In a financial crisis, banks usually become vulnerable, forcing the central bank to provide stability to the economy by reducing interest rates, which is difficult to do in an already low interest rate environment.

LOS 16.l

Macroeconomic links refer to similarities in business cycles across countries. Economies are linked by both international trade and capital flows so that a recession in one country dampens exports and investment in a second country, thereby creating a slowdown in the second country.

Exchange rate links are found when countries peg their currency to others. The benefit of a peg is that currency volatility is reduced and inflation can be brought under control. Interest rates between the countries will often reflect a risk premium, with the weaker country having higher interest rates.

Interest rate differentials between countries can also reflect differences in economic growth, monetary policy, and fiscal policy.

LOS 16.m

Emerging market risks stem from unstable political and social systems and heavy infrastructure investments financed by foreign borrowing. Investors should answer six questions before investing in these markets:

1. Does the country have responsible fiscal and monetary policies? This is determined by examining the deficit to GDP ratio.

2. What is the expected growth? Should be at least 4%.
3. Does the country have reasonable currency values and current account deficits? A volatile currency discourages needed foreign investment, and an overvalued currency encourages excessive government borrowing.
4. Is the country too highly levered? Too much debt can lead to a financial crisis if foreign capital flees the country.
5. What is the level of foreign exchange reserves relative to short-term debt? Many emerging country loans must be paid back in a foreign currency.
6. What is the government's stance regarding structural reform? A supportive government makes the investment environment more hospitable.

LOS 16.n

Econometric analysis utilizes economic theory to formulate the forecasting model. The models range from being quite simple to very complex, involving several data items of various time period lags to predict the future.

Economic indicators attempt to characterize an economy's phase in the business cycle and are separated into lagging indicators, coincident indicators, and leading indicators. Analysts prefer leading indicators because they help predict the future path of the economy.

In a checklist approach, the analyst checks off a list of questions that should indicate the future growth of the economy. Given the answers to these questions, the analyst can then use his judgment to formulate a forecast or derive a more formal model using statistics.

LOS 16.o

Investors ultimately use capital market expectations to form their beliefs about the attractiveness of different investments. Following are examples of how specific information can be used to forecast asset class returns.

- If a cash manager thought that interest rates were set to rise, she would shift to short-term cash instruments.
- A change in short-term rates has unpredictable effects for the yields on long-term bonds.
- During a recession, the risk premium on credit risky bonds increases.
- Most emerging market debt is denominated in a non-domestic currency, which increases its default risk.
- The yields for inflation-indexed bonds will fall if inflation increases.
- In the early expansion phase of the business cycle, stock prices are increasing. Later in the expansion, earnings growth and stock returns slow.
- The returns for emerging market stocks are affected by business cycles in the developed world.
- Interest rates affect real estate returns through both the supply and demand as well as the capitalization rate used to discount cash flows.

LOS 16.p

When the government promotes competition in the marketplace, the efficiency of the economy increases, likely leading to higher long-term growth in the economy and the stock market.

Shorter-term growth is affected by the business cycle. In a recession, sales and earnings decrease. Non-cyclical or defensive stocks are less affected by the business cycle and thus will have lower risk premiums and higher valuations than cyclical stocks. Cyclical stocks are characterized by high business risk and/or high fixed costs.

LOS 16.q

- The relative form of purchasing power parity (PPP) states that differences in inflation between two countries will be reflected in changes in the exchange rate between them. Specifically, the country with higher inflation will see its currency value decline.
- The relative economic strength approach: The idea behind this approach is that a favorable investment climate will attract investors, which will increase the demand for the domestic currency, therefore increasing its value.
- The capital flows approach focuses primarily on long-term capital flows such as those into equity investments or foreign direct investments.
- The savings-investment imbalances approach starts with the concept that an economy must fund investment through savings. If investment is greater than domestic savings, then capital must flow into the country from abroad to finance the investment.

LOS 16.r

Be able to discuss how the relationships covered in the previous LOS can be used in assessing relative attractiveness of asset classes (i.e., using historically based estimates of expected return and risk, Singer-Terhaar, phases of the business cycle, and the Taylor rule).

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 16.1

1. The analyst has not been systematic and has used inconsistent assumptions. In this case, the result is overstating the attractiveness of equity and understating the attractiveness of fixed income. The result would be allocating too much to equity. (LOS 16.a)

2. Pro: The recent three-year period is more likely to reflect the current economic and political environment.

   Con: The recent shorter period does not reflect the full course of a business cycle or a variety of possible economic conditions.

   Pro: The longer period is more likely to reflect various economic conditions that can occur.

   Con: The longer period is more likely to be subject to regime change, be nonstationary, and reflect conditions that are no longer relevant. (LOS 16.b)

3. Some types of alternative investments are not regularly traded, and only infrequent prices (smoothed data) are available.

   This has no systematic effect on the estimated returns, but it makes the calculated standard deviation lower because there are no actual periodic changes in value (there are no prices to examine). The smoothed return data also appears to be less correlated with the more erratic pricing of other asset classes that have and report actual trading prices. The correlation will appear closer to zero. (LOS 16.b)

Module Quiz 16.2

1. The analyst would most likely forecast the variance using time series analysis. In time series analysis, forecasts are generated using previous values of a variable and previous values of other variables. If an exchange rate exhibits volatility clustering, then its variance will persist for periods of time and can be forecasted using a time series model. (LOS 16.c)

2. The equation for expected return on Tel-Pal, Inc., using these inputs is:

$$\widehat{R}_T = \frac{Div_1}{P_0} + \text{inflation} + \text{real growth in earnings} - \%\Delta\text{shares} + \Delta\left(\frac{P}{E}\right)$$

$$\widehat{R}_T = \left(\frac{\$3}{\$75} \times 100\right) + 3.5\% + 3.3\% - 2\% + 0$$

$$\widehat{R}_T = 8.8\%$$

The expected return is 8.8%. The expected dividend return is 4%, and the expected percentage increase in the number of shares is 2%. Expected inflation is 3.5%, which should be subtracted from the nominal earnings forecast to get the forecast of real earnings growth. (LOS 16.c)

3. The shrinkage estimate is simply the weighted average of the historical value and the forecasted value. The shrinkage estimate is:

   856 = 30% × 1,024 + 70% × 784

   (LOS 16.c)

Module Quiz 16.3, 16.4

1. First, we calculate the equity risk premium for both markets assuming full integration. Note that for Market B, the illiquidity risk premium is added in:

$$\text{ERP}_i = \rho_{i,M}\sigma_i\left(\frac{\text{ERP}_M}{\sigma_M}\right)$$

   ERPA = 0.87(0.18)0.29 = 4.54%

   ERPB = 0.63(0.26)0.29 + 0.0240 = 7.15%

   The equity risk premium for both markets assuming full segmentation is:

$$\text{ERP}_i = \sigma_i\left(\frac{\text{ERP}_M}{\sigma_M}\right)$$

   ERPA = (0.18)0.29 = 5.22%

   ERPB = (0.26)0.29 + 0.0240 = 9.94%

   Weighting the integrated and segmented risk premiums by the degree of integration and segmentation in each market:

   ERPA = (0.80 × 0.0454) + [(1 − 0.80) × 0.0522] = 4.68%

   ERPB = (0.65 × 0.0715) + [(1 − 0.65) × 0.0994]= 8.13%

   The expected return in each market is then:

$$\widehat{R}_A = 5\% + 4.68\% = 9.18\%$$
$$\widehat{R}_B = 4.5\% + 8.13\% = 12.63\%$$

The betas in each market are:

βi = ρi, Mσi / σM

βA = (0.87)(18) / 8 = 1.96

βB = (0.63)(26) / 8 = 2.05

The covariance is then:

$$\mathbf{cov}_{i,j} = \beta_i \beta_j \sigma_M^2$$

covA,B = (1.96)(2.05)(8.0)2 = 257.15

(Module 16.3, LOS 16.c)

2. Bonds actually perform well during periods of falling inflation or deflation because interest rates are declining. This holds true as long as credit risk does not increase. Equities do poorly in periods of declining inflation or deflation due to declining economic growth and asset prices. Deflation also reduces the value of investments financed with debt, such as real estate, because leverage magnifies losses. Deflation is negative for cash because the return on cash declines to near zero. (Module 16.4, LOS 16.g)

3. A slowing in the growth of the aggregate inventory-to-sales ratio in an economy is associated with later stages of the business cycle, perhaps late upswing or slowdown. It is likely caused by less business optimism with reductions in production and employment, hence a lower rate of economic growth.

   Business has adopted just-in-time inventory approaches and generally reduced the amount of inventory they hold. As a result, inventory-to-sales ratios have declined in general and are independent of the stage of the business cycle. (Module 16.4, LOS 16.e)

4. **C** *Early Expansion:* In this period of the business cycle, we expect to observe rising short-term interest rates and flat or rising bond yields.

   The expectations of short-term and long-term yields for the other phases are listed as follows:

   Late Expansion: Both short-term and long-term rates increase.

   Initial Recovery: Low or falling short-term rates, and bond yields have bottomed out. (Module 16.4, LOS 16.f)

Module Quiz 16.5

1. Her conclusion may not be warranted. In an economic expansion, the budget deficit will decline naturally because tax receipts increase and disbursements to the unemployed decrease. The changes she is observing may be independent of the government's fiscal policy.

   Note that only government-directed changes in fiscal policy influence the growth of the economy. Changes in the deficit that occur naturally over the course of the business cycle are not stimulative or restrictive. (LOS 16.h)

2. r_{target} = 5.0% + [0.5 × 5% – 3%) + 0.5 × (6% – 3%)

   = 5% + [1.0% + 1.5%] = 7.5%

   In this example, the higher than targeted growth rate and higher than targeted inflation rate argue for a targeted interest rate of 7.5%. This rate hike is intended to slow down the economy and inflation. (LOS 16.h)

3. If the yield curve is steeply upwardly sloping, then it is likely that both fiscal and monetary policies are expansive. The economy is likely to expand in the future. (LOS 16.i)

Module Quiz 16.6

1. Although consumer spending is the largest component of GDP, it is fairly stable over the business cycle as consumers primarily base spending decisions on more stable, permanent income rather than more volatile, immediate income. Thus, it is likely that the analyst should focus on the potential changes in tax policy. This governmental structural policy has a potentially large impact on the long-run growth rate of an economy. (LOS 16.j)

2. When exports are less than imports, a current account deficit usually results. This can be problematic because the deficit must be financed through external borrowing. If the emerging country becomes overleveraged, it may not be able to pay back its foreign debt. A financial crisis may ensue where foreign investors quickly withdraw their capital. These financial crises are accompanied by currency devaluations and declines in emerging market asset values. (LOS 16.j)

Module Quiz 16.7, 16.8

1. A global economic slowdown would affect smaller countries with undiversified economies more because economic links are more important for these types of countries. Larger countries with diverse economies are less affected by events in other countries. (Module 16.7, LOS 16.l)

2. Econometric analysis would be the best approach to use. It can model the complexities of reality using both current and lagged values. Ordinary least squares regression is most often used, but other statistical methods are also available. (Module 16.8, LOS 16.n)

3. Greater currency and economic stability: True. The peg is likely to create a more stable currency that provides confidence for investors and business, both of which promote economic stability. Maintaining the peg prevents excessive money creation, which holds down inflation and also promotes economic stability. The peg is a commitment to follow the policies needed to maintain the value of the currency.

   Relatively lower and more stable interest rates: Partially true (or partially false). Interest rates will be related to but higher than the country to which the currency is pegged. The interest rate premium will reflect the investor's perception of the country's commitment and ability to maintain the peg. If that comes into question, the country will likely have to increase interest rates in order to maintain the currency value. The goal of the peg is lower and more stable rates, but if the peg fails, the opposite can occur.

   Pursue the fiscal and economic policies to maximize the country's real economic growth: False. The country must largely follow the economic policies of the country to which it is pegged. These may or may not be optimal for the country's growth. (Module 16.7, LOS 16.l)

Module Quiz 16.9, 16.10

1. **C** The savings-investment imbalances approach begins by stating that a savings deficit exists when investment is greater than domestic savings. To compensate for a savings deficit, a country's currency must increase in value and stay strong to attract and keep foreign capital. At the same time the country will have a current account deficit where exports are less than imports. Although a current account deficit would normally indicate that the currency would weaken, the currency must stay strong to attract foreign capital. (Study Session 8, Module 16.9, LOS 16.q)

2. **C** The PPP relationship states that countries with high inflation will see their currency depreciate, so the manager should invest in Japan. Within Japan, the investor should invest in stocks because stock prices have just started to rise and will continue to do so for some time. Bond yields will soon rise and their prices will fall as the economy expands. (Study Session 8, Module 16.10, LOS 16.r)

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1. Richard Grinold and Kenneth Kroner, "The Equity Risk Premium," *Investment Insights* (Barclay's Global Investors, July 2002).

2. Accessible at www.philadelphiafed.org; accessed July 2018.

The following is a review of the Applications of Economic Analysis to Portfolio Management principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #17.

READING 17: EQUITY MARKET VALUATION

Study Session 8

EXAM FOCUS

Any of the calculations and approaches in this Topic Assignment are fair game for the exam. Some may be familiar from other levels of the exam and some will be new. The focus will be on formulating capital market expectations for the equity asset class and not on individual security valuation. Also be prepared for conceptual questions regarding implications or drawing conclusions when there is insufficient data for a calculation but sufficient data for a directional conclusion.[1]

MODULE 17.1: COBB-DOUGLAS PRODUCTION FUNCTION

LOS 17.a: Explain the terms of the Cobb-Douglas production function and demonstrate how the function can be used to model growth in real output under the assumption of constant returns to scale.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 128

The **Cobb-Douglas production function (CD)** is used in the neoclassical approach to estimate a country's production function. CD uses the country's labor input and capital stock to estimate the total real economic output. The general form of the function is:

$Y = AK^{\alpha}L^{\beta}$

where:

Y = total real economic output

A = total factor productivity (TFP)

K = capital stock

L = labor input

α = output elasticity of K ($0 < \alpha < 1$)

β = output elasticity of L (α + β = 1)

However, it is more useful in security analysis to rearrange the equation to estimate future economic growth. Applying natural logs, assuming that β = (1 − α), and making a few other assumptions, we see the form of the CD that is used to estimate *expected changes* in real economic output. Each of the inputs, as well as the output, is now stated in terms of growth (i.e., percentage change), a simple linear equation:

$$\frac{\Delta \mathrm{Y}}{\mathrm{Y}} \cong \frac{\Delta \mathrm{A}}{\mathrm{A}} + \alpha \frac{\Delta \mathrm{K}}{\mathrm{K}} + (1 - \alpha) \frac{\Delta \mathrm{L}}{\mathrm{L}}$$

where:

$\frac{\mathrm{Y}}{\mathrm{Y}}$ = % change in real output (%ΔY)

$\frac{\mathrm{A}}{\mathrm{A}}$ = % change in total factor productivity (%ΔTFP)

$\frac{\mathrm{K}}{\mathrm{K}}$ = % change in capital stock (%ΔK)

$\frac{\mathrm{L}}{\mathrm{L}}$ = % change in labor (%ΔL)

Empirical studies also suggest it is reasonable to assume *constant returns to scale*, any given change in capital or labor (for example, from 2% to 3% or 5% to 6%) has a linear effect on output. Constant returns to scale also means TFP can be assumed to be a constant. This is an elaborate way of saying the linear version of Cobb-Douglas produces reasonable results.

Assume both capital and labor increase by 4%, and TFP is 2%. The resulting expected change in real GDP is 6%.

$$\begin{aligned} \%\Delta \mathrm{Y} &= \%\Delta \mathrm{TFP} + \alpha\,(\%\Delta \mathrm{K}) + (1-\alpha)\,\%\Delta \mathrm{L} \\ &= 2\% + \alpha\,(4\%) + (1-\alpha)\,4\% = 6\% \end{aligned}$$

More realistic assumptions might have capital and labor grow by different rates. Suppose TFP, capital, and labor increase by 1.7%, –0.5%, and 2.1% respectively, with α = 0.35:

$$\begin{aligned} \% \quad \mathrm{Y} &= 1.7\% + 0.35\,(-0.5\%) + 0.65\,(2.1\%) \\ &= 1.7\% + -0.175\% + 1.365\% = 2.89\% \end{aligned}$$

Estimating TFP (the Solow Residual)

Percentage changes in capital and labor can be obtained from national accounts, and α and β, the output elasticities of capital and labor, vary from country to country. The change in TFP (i.e., %ΔA) is the **Solow residual** and can be determined by rearranging the equation:

Solow residual = %ΔTFP = %ΔY − α(%ΔK) − (1 − α)%ΔL

An economy's TFP can change over time due to the following:

- Changing technology.
- Changing restrictions on capital flows and labor mobility.
- Changing trade restrictions.
- Changing laws.
- Changing division of labor.
- Depleting/discovering natural resources.

Essentially, TFP is the rate of managerial and technological innovation, measuring the ability of an economy to produce more real output for the same inputs of labor and capital.

LOS 17.b: Evaluate the relative importance of growth in total factor productivity, in capital stock, and in labor input given relevant historical data.

CFA® Program Curriculum, Volume 3, page 132

Estimating the inputs for CD typically starts with historical data to estimate past values. It is important to select past time periods that are expected to be similar to the future period or otherwise adjust past data to better reflect expected future conditions.

EXAMPLE: Effects of changing factors on economic growth

Factor	Direction of Factor Change	Consequences for Economic Growth
Savings rate	Increase	Increase as a greater supply of financial capital lowers real interest rates and increases the growth rate of physical capital.
Population growth rate	Increase	Increase as the labor force growth rate increases.
Labor force participation rate	Increase	Increase as the rate of growth in labor can increase independent of the underlying population growth rate.
Environmental, pollution controls, and regulation	Increase	Associated with a one-time decrease in growth and TFP.
Reform measures	Increase	Associated with a one-time increase in growth and TFP.

Miscellaneous other factors can also affect TFP and growth. Those factors include production processes, literacy, and skills of the workforce.

EXAMPLE: Estimating the change in economic output

While performing an analysis of three economies, an analyst compiled the growth and elasticity data in the following table.

10-Year Forecast (Growth Figures Are Annual Averages)

Country	% Growth in Total Factor Productivity	% Growth in Capital Stock	% Growth in Labor Input	Output Elasticity of Capital (α)
A	1.0	2.0	1.0	0.5
B	2.0	2.5	4.5	0.3
C	3.0	8.0	2.5	0.7

1. For each economy, **determine** the expected 10-year average annual GDP growth rate.
2. **Comment** on the three economies.

Answer:

1. Expected growth in GDP:

   $\%\Delta Y \cong \%\Delta A + \alpha(\%\Delta K) + (1 - \alpha)(\%\Delta L)$

   A: $\%\Delta Y = 1.0 + 0.5(2.0) + 0.5(1.0) = 2.50\%$

   B: $\%\Delta Y = 2.0 + 0.3(2.5) + 0.7(4.5) = 5.90\%$

   C: $\%\Delta Y = 3.0 + 0.7(8.0) + 0.3(2.5) = 9.35\%$

2. Over the next ten years, economies A, B, and C are expected to experience average annual GDP growth rates of 2.50%, 5.90%, and 9.35%, respectively. The population of Economy A would appear to be close to equilibrium, as it is expected to grow at an average annual rate of only 1%. Together, the lower growth rates in capital, labor, TFP, and output for Economy A suggest a mature, developed economy.

   The workforce growth rate of 4.5% for Country B is relatively high, and Country B gains significantly from growth in the workforce. Increases in the capital stock, on the other hand, have less of an effect on output. The impressive workforce growth rate combined with a modest expected growth in capital stock could indicate an immature economy, perhaps entering the early stages of development.

   Growth in the workforce of Economy C has slowed. Capital stock, however, is expected to increase significantly over the next ten years. Relative to Economy B, rapidly growing capital stock combined with an ability to translate capital growth into increased economic output (i.e., α = 0.7) indicates an economy moving rapidly toward a more developed status.

MODULE QUIZ 17.1

To best evaluate your performance, enter your quiz answers online.

1. Fenledder also gathered data for Equity Market Index Z as shown in Table B:

   Table B: Economic Data for Equity Market Index Z

Expected growth in total factor productivity	1.5%
Expected growth in labor	3.0%
Expected growth in capital stock, α = 0.6	2.2%

a. **Explain** each of the terms in the Cobb-Douglas production function (CD) as it is used to forecast economic growth.

b. **Calculate** the implied growth (percentage change) for Market Z using the data in Table B.

c. **Explain** the Solow residual and **state** three factors that would likely produce a long-term change in its value.

2. In the template provided, **indicate** and **explain** the effect on the growth of an economy, given the indicated change in the following growth factors:

   i. Slowing growth of the population.

   ii. Decrease in the government-mandated retirement age.

   iii. Relaxation of import duties and other trade restrictions.

   iv. Tax relief to encourage technological innovation.

   Template for Question 2:

Factor	Effect on Economic Growth (circle one)	Explanation
i. Slowing growth of the population.	Increase Decrease	
ii. Decrease in the government- mandated retirement age.	Increase Decrease	
iii. Relaxation of import duties and other trade restrictions.	Increase Decrease	
	Increase	

iv. Corporate tax relief to encourage technological innovation.	Decrease

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MODULE 17.2: DIVIDEND DISCOUNT MODELS

LOS 17.c: Demonstrate the use of the Cobb-Douglas production function in obtaining a discounted dividend model estimate of the intrinsic value of an equity market.

LOS 17.d: Critique the use of discounted dividend models and macroeconomic forecasts to estimate the intrinsic value of an equity market.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, pages 133 and 138

Cobb-Douglas provides a macroeconomic forecast of the growth rate for the underlying economy and this is the base for estimating cash flow and dividend growth rates for dividend discount models (DDM). There are likely to be significant differences and challenges in applying DDM to developed markets versus less developed and emerging markets.

For **developed markets**, the corporate share of aggregate economic activity and dividend payouts are likely to be relatively stable. Therefore, both dividend and economic growth rates will be closely tied. In addition, long-term trend growth is more stable making the Gordon Growth (single stage) DDM model appropriate. Finally, risk should be more predictable and stable, making the appropriate discount rate more predictable.

For **less developed economies**, the challenges are greater and they make the H-model (two stage growth) DDM a more reasonable approach to valuing such markets. The challenges include:

- Economic data is less available and less reliable.
- The link between economic and corporate cash flow/dividend growth is less direct.
    - Structural and governmental changes can lead to long periods when the growth rates of the two diverge.
- Periods of dramatic change in inflation can disrupt valuation input estimates. As a result:
    - Growth rates can diverges dramatically from historical rates.
    - Estimating suitable discount rates to reflect risk is substantially more difficult.
    - Economies are likely to show more dramatic fluctuation in annual growth.

Gordon Growth Model (GGM) for Mature Economies

$$V_0 = \frac{D_1}{r - \bar{g}} = \frac{D_0\,(1 + \bar{g})}{r - \bar{g}}$$

H-Model for Emerging Economies

$$V_0 = \frac{D_0}{r - g_L}\left[(1 + g_L) + \frac{N}{2}(g_S - g_L)\right]$$

where:

V_0 = the theoretical fair (intrinsic) value for the market

D_0 = current dividend

r = the real discount rate

$\overline{g}$ = the real single stage growth rate

g_L = the real long term sustainable (lower) growth rate

g_S = the real shorter term (higher) growth rate

N = the number of years over which g_S converges in linear fashion to g_L

The preference is to use real (before inflation) rather than nominal values in the models when estimating intrinsic value for markets because:

- Cobb-Douglas is commonly used to estimate the real growth rate.
- Inflation rates fluctuate over time and vary between countries making it easier to compare real data.
- With inflation excluded, real inputs tend to be more stable and thus easier to estimate.

Variations on the DDM approaches:

- To facilitate comparison of results over time and between countries, a common approach is to divide V_0 by E_1 to calculate a justified P/E ratio. $\frac{V_0}{E_1} = \frac{D_1}{(r-g)E_1} = \frac{1-b}{r-g}$
- The GGM can be easily used to solve for either the implied growth rate or *r* by inserting the actual price of the market (P_0) into the formula and solving for the desired item. P0->r P0->g
  - If the analyst believes growth will be higher/lower than implied growth, the market is under-/overvalued.
  - When implied *r* is calculated, it becomes the long-term estimated return that will be earned based on initial market price (if the market is reasonably valued initially). If the analyst believes implied *r* is higher/lower than appropriate, then the market is under-/overvalued.

EXAMPLE: Estimating the intrinsic value and justified P/E ratio of a developing equity market

To estimate the intrinsic value of a developing market index using the H-Model, we need the real required return (*r*= 10%), the current dividend (D_0 = 12), the supernormal rate of growth (g_S= 10.5%), the long-term sustainable rate of growth (g_L = 3%), and the period of time (*N* = 30) over which the growth rate will decline linearly. Forecasted EPS are 20.30.

Answer:

Justified P/E is based on forecasted EPS:

$$\begin{aligned} V_0 &= \frac{D_0}{r-g_L}\left[(1+g_L)+\frac{N}{2}(g_S-g_L)\right] \\ &= \frac{12}{0.10-0.03}\left[(1.03)+\frac{30}{2}(0.105-0.03)\right] = 369.43 \end{aligned}$$

P / E (justified) = 369.43/20.30 = 18.199 = 18.20

EXAMPLE: Estimating the sustainable rate of growth, required return, and intrinsic value of a developed equity market

An analyst has gathered the data in the following table for a large, mature developed market index. The current level of the index is 3,250, and the current dividend is $150.

Long-Term Economic Growth Factors

% Growth in Total Factor Productivity	% Growth in Capital Stock	% Growth in Labor Input	Output Elasticity of Capital (α)	Output Elasticity of Labor (1 − α)
1.5	1.5	0.5	0.6	0.4

1. **Determine** the implied sustainable rate of growth in GDP.
2. Using the growth rate calculated in *i*, **calculate** the required market return.
3. The analyst believes a required return of 7.0% is appropriate for this market. Based on the analyst's required return, **calculate** the intrinsic value of the index.

Answer:

1. Based on the expected long-term rates of change in capital, labor, and total factor productivity, the long-term sustainable growth in GDP is estimated at 2.6%:

$$\%\Delta Y \cong \%\Delta A + \alpha(\%\Delta K) + (1-\alpha)(\%\Delta L) = 1.5 + 0.6(1.5) + 0.4(0.5) = 2.6\%$$

2. Because this is a mature, developed market, we can use the constant growth dividend discount model, rearranged to solve for *r*, to estimate the market required return:

$$P_0 = \frac{D_1}{r-g} = \frac{D_0(1+g)}{r-g} \Rightarrow r = \frac{D_0(1+g)}{P_0} + g$$

$$r = \frac{150(1+0.026)}{3,250} + 0.026 = \frac{153.90}{3,250} + 0.026 = 0.07335 = 7.3\%$$

3. Using the current dividend of $150, the long-term sustainable rate of growth of 2.6%, and the analyst's required return of 7.0%, the analyst would estimate the intrinsic value of the index at 3,498:

$$P_0 = \frac{D_1}{r-g} \Rightarrow \frac{153.90}{0.07-0.026} \cong 3,498$$

Based on the analyst's estimated required return, the index is undervalued by 3,498 – 3,250 = 248 points or 7.1% below fair value.

MODULE 17.3: TOP-DOWN VS. BOTTOM-UP

LOS 17.e: Contrast top-down and bottom-up approaches to forecasting the earnings per share of an equity market index.

CFA® Program Curriculum, Volume 3, page 141

Video covering this content is available online.

In a **top-down forecast**, the analyst utilizes macroeconomic factors (e.g., interest rate expectations, expected growth in GDP) to estimate the performance of market-wide indicators, such as the S&P 500. Successive steps include identifying sectors in the market that will perform best, given market expectations.

The analyst could start by comparing the relative values of various market composites to their historical patterns to identify any that appear to be under- or over-priced. Next, the analyst could attempt to identify any momentum in the indices. In the final macro-analysis, the analyst compares the expected performance of the indices to general asset classes, such as equities, bonds, and alternatives to identify which class of assets will be expected to under- or out-perform. After selecting asset classes to over- or under-weight, the analyst could move down to sector and security selection if desired.

In a **bottom-up forecast**, the analyst first takes a microeconomic perspective by focusing on the fundamentals of individual firms. The analyst starts the bottom-up analysis by looking at an individual firm's product or service development relative to the rest of the industry. The analyst should assess the firm's management and its willingness and ability to adopt the technology necessary to grow or even maintain its standing in the industry. Given the analyst's expectations for the firm, the analyst uses some form of cash flow analysis to determine the firm's investment potential (i.e., expected return). If desired, the individual security analysis could be aggregated up into sector and asset class returns that could be compared to the top-down estimates.

Which to Use

The method used depends on the analyst's strategy, as well as any portfolio constraints. For example, a manager who focuses on a long-short, market-neutral strategy would probably pursue a purely bottom-up analysis. The manager has little need for aggregating the forecasts for individual securities into industry or market forecasts. Another manager's strategy could focus on allocating among markets or industries. In these cases, there is little need for the top-down manager to go any lower, or the bottom-up manager to go any higher, than the first step.

For the Exam: To determine which approach is better for the manager, you will have to determine the manager's focus. For example, if you encounter a macro hedge fund manager who focuses on optimal allocations of global markets or currencies, a purely top-down approach would be indicated. An active manager who buys and sells individual securities to capture short-term pricing inefficiency should utilize a bottom-up approach.

Estimating Market Earnings Per Share (EPS)

Analysts are sometimes encouraged to confirm market EPS estimates by using both the top-down and bottom-up methods. If the methods yield significantly different estimates, the analyst should analyze both estimates to determine the source(s) of discrepancy. There are two primary reasons why forecasting earnings per share with the two methods can yield different results:

1. *The models used in a top-down analysis*. Econometric models use historical values and variables adjusted to varying degrees by the user, and they suffer from the same weaknesses as all such models. For example, they may be slow in capturing structural changes (i.e., changes in the sensitivities of the individual factors). The model might have worked well in the past, but recent structural changes might have altered the relationships between the independent and dependent variables.

   The models can also be specified incorrectly. Variables in the model that explained behavioral and financial relationships in the past might no longer be appropriate, and/or other variables might be more appropriate.
2. *Manager bias*. A bottom-up analysis is usually based, to a degree, on manager expectations. Because most managers expect their firms to out-perform the industry average, aggregating individual manager expectations can lead to significantly over-estimated industry expectations.

   Also, believing they can hold on longer than other firms as the economy sinks into a recession, individual managers tend to be more optimistic than would be warranted by a top-down model. On the other hand, they will tend to be more pessimistic as the market begins to recover. The potential for these biases must be assessed when the economy is entering or leaving a recession. If there is evidence of significant manager bias, the top-down method might be more appropriate.

> **For the Exam:** The bottom line is that both top-down analysis and bottom-up analysis have strengths and weaknesses. Top-down analysis doesn't incorporate the input of individual managers, while individual managers tend to be overly optimistic about their firm's future. Be able to recognize the deficiencies of each method and discuss the implications.

MODULE QUIZ 17.2, 17.3

To best evaluate your performance, enter your quiz answers online.

1. **Describe** top-down and bottom-up economic analysis. **Explain** the situations that would imply when either a top-down or a bottom-up analysis would be more appropriate and when the use of both would be justified.

2. In the template provided, **determine** whether a top-down or bottom-up forecast would be better indicated for each scenario. **Justify** your selection.

Template for Question 2:

Scenario	**Top-Down or Bottom-Up (circle one)**	**Justification**
A global macro-hedge fund takes large positions in foreign currencies.	Top-down Bottom-up	
Portfolio manager Active A employs a market neutral strategy and adds market exposure with equity futures.	Top-down Bottom-up	
Active Investors, LLP, advertises that they earn alpha through stock selection.	Top-down Bottom-up	

MODULE 17.4: FED MODEL

Relative Equity Market Valuation

Video covering this content is available online.

LOS 17.f: Discuss the strengths and limitations of relative valuation models.

LOS 17.g: Judge whether an equity market is under-, fairly, or over-valued using a relative equity valuation model.

CFA® Program Curriculum, Volume 3, pages 147 and 148

Relative value models use the relative values of assets and markets to identify investment opportunities. In the following material, we will discuss three relative value models: (1) the Fed model, (2) the Yardeni model, and (3) the 10-year Moving Average Price/Earnings model. These models are used to assess the relative attractiveness of stocks versus bonds.

The **Fed model** assumes that the expected operating earnings yield on the S&P 500 (i.e., expected aggregate operating earnings divided by the current index level) should be the same as the yield on long-term U.S. Treasuries:

$$\text{Fed model ratio} = \frac{\text{S\&P earnings yield}}{\text{10-year Treasury yield}}$$

If the S&P 500 earnings yield is higher than the Treasury yield, the interpretation is that the index value is too low relative to earnings. Equities are undervalued and should increase in value. Likewise, if the earnings yield is lower than the Treasury yield, the index is considered too high for the level of earnings. Equities are over-valued and should fall.

There are three basic criticisms of the Fed model, based on implied assumptions regarding risk, growth, and inflation.

The Fed model does the following:

1. *Ignores the equity risk premium.* Assuming the yield on treasuries is the same as the earnings yield on the S&P ignores the inherent risk of equities.
2. *Ignores earnings growth.* Growth expectations affect earnings, but Treasury yields have no growth components. By assuming the yield on a Treasury should be the same as corporate earnings yield, the model implicitly assumes zero growth in earnings.
3. *Compares a real variable to a nominal variable.* Earnings yield is considered a real variable because the future level of earnings is not fixed and in the long run tends to adjust upward with inflation. A stock investor tends to benefit from rising future inflation compared to a bond investor. In contrast, the Treasury yield is a nominal rate. The build up model of interest rates decomposes the stated nominal yield into a real rate and expected future inflation. From the investor's perspective, once a bond is purchased the cash flows are fixed and do not adjust for the actual future course of inflation.

Although flawed, the Fed model is used by analysts in a type of spread analysis. Rather than assume the two yields should be equal, as in the model, analysts watch the *ratio* of the earnings and Treasury yields. When the ratio is above its long-term average, the difference between the earnings yield and Treasury yield (the spread) is historically high. Equity prices would be expected to increase, lowering the earnings yield and, thus, the ratio of the two yields (i.e., the yield spread would narrow).

> **For the Exam:** If asked to list criticisms of the Fed model, mention that it:
>
> - Does not consider the equity risk premium.
> - Ignores growth in earnings.
> - Compares a real variable (index level) to a nominal variable (Treasury yield).

MODULE 17.5: THE YARDENI MODEL

The **Yardeni model** for estimating the equilibrium earnings yield (i.e., the fair earnings yield) is based on a variation of the constant growth dividend discount model (CGM), in which investors value total earnings rather than dividends:

Video covering this content is available online.

$$P_0 = \frac{E_1}{r - g}$$

We can restate the CGM to show that the earnings yield must be the difference between the required return on equity and expected long-term growth. This is logical, because we assume the total return on equity, *r*, must be the sum of the earnings yield, E_1 / P_0, and growth (i.e., capital gains), *g*:

$$P_0 = \frac{E_1}{r - g} \Rightarrow r = \frac{E_1}{P_0} + g \Rightarrow \frac{E_1}{P_0} = r - g$$

Yardeni incorporates risk into his model by using the yield on A-rated corporate bonds, Y_B, as the required return on equity, *r*. The difference between the yields on A-rated corporates and risk-free treasuries serves as a proxy, although most likely understated, for the equity risk premium. Also, instead of the long-term growth assumed in the CGM, Yardeni uses a 5-year growth forecast, LTEG,[2] for the S&P 500. The model becomes:

LTEG is the 5-year consensus growth forecast provided by Thomson Financial

$$\frac{E_1}{P_0} = Y_B - d\,(\text{LTEG})$$

where:

$\frac{E_1}{P_0}$ = expected market (e.g. S&P) earnings yield

Y_B = yield on A-rated corporate bonds

d = weighting factor for the importance of earnings growth; historically around 0.10

Y_B − d(LTEG) = Yardeni earnings yield

PROFESSOR'S NOTE

Yardeni uses the yield on A-rated corporates. Viewed from the perspective of a build up model, this would include the risk-free rate plus a default premium. Effectively, the default premium is approximating the equity risk premium. Then, to account for the fact that the earnings yield on the left-hand side of the equation ignores growth, he subtracts a growth factor.

The terms P_0 and V_0 are not used consistently in this reading. Whenever one of the models discussed is used to solve for P_0 or P/E or E/P, the model is solving for the theoretical fair valve of that item.

The earnings yield from the Yardeni model is compared to the market earnings yield. If the market yield is high compared to the Yardeni earnings yield, equities are underpriced. Equities would be expected to rise in value, reducing the market earnings yield.

$$\text{if} \frac{E_1}{P_0} - [Y_B - d\,(\text{LTEG})] > 0 \Rightarrow \text{market is undervalued}$$

$$\text{if} \frac{E_1}{P_0} - [Y_B - d\,(\text{LTEG})] < 0 \Rightarrow \text{market is overvalued}$$

Like the Fed model, the Yardeni model can be applied as a ratio:

$$\text{if}\frac{E_1}{P_0} - [Y_B - d\,(LTEG)] > 0 \Rightarrow \frac{\text{earnings yield}}{Y_B - d(LTEG)} > 1.0 \Rightarrow \text{market is undervalued}$$

$$\text{if}\frac{E_1}{P_0} - [Y_B - d\,(LTEG)] < 0 \Rightarrow \frac{\text{earnings yield}}{Y_B - d(LTEG)} < 1.0 \Rightarrow \text{market is overvalued}$$

The Yardeni model can also be used to estimate a fair value for the equity market. If we rearrange the model to solve for P_0, it starts to look like the traditional CGM with Y_B in place of the required return and *d(LTEG)* in place of *g*:

$$\frac{E_1}{P_0} = Y_B - d\,(LTEG) \Rightarrow V_0 = \frac{E_1}{Y_B - d\,(LTEG)}$$

EXAMPLE: Using the Yardeni Model

1. Assume the long-term (5-year) growth forecast is 9.85% and d = 0.10. If A-rated corporate bonds yield 6%, **determine** the fair earnings yield.
2. If the current earnings yield implied by the equity index and projected forward earnings is 5.5%, **determine** whether equities are over- or undervalued.
3. Using the Yardeni model, **calculate** a fair value of the market P/E ratio.

Answer:

1. $$\frac{E_1}{P_0} = Y_B - d\,(LTEG)$$
   $$= 0.06 - 0.10\,(0.0985) = 0.05015 = 5.015\%$$
2. The fair earnings yield predicted by the Yardeni model is about 5%. If the current market earnings yield is 5.5%, this would imply that the value of the index is too low compared to projected earnings. According to the Yardeni model the market is *undervalued*.
3. The Yardeni model calculates the fair earnings ratio, which is the ratio of earnings to price. To convert the earnings ratio to a P/E ratio, we simply invert it:

$$\frac{E_1}{P_0} = 0.05015 \;\Rightarrow\; \frac{P_0}{E_1} = \frac{1}{0.05015} = 19.94$$

For the Exam: When answering questions about the Yardeni model, important considerations include the following:

- It incorporates a proxy for the equity market risk premium (the yield on A-rated corporate debt).
- The risk premium used is actually a measure of default risk, not a true measure of equity risk.
- It relies on an estimate of the value investors place on earnings growth (d), which is assumed to be constant over time.
- The growth rate used in the model (LTEG) might not be an accurate estimate of long-term sustainable growth.

MODULE 17.6: CAPE

Cyclically Adjusted P/E Ratio (CAPE)

CAPE is computed as the price of a broad market index to its trailing 10-year moving average of earnings. If the CAPE is above its historical average, the market is presumed to be overvalued. If the CAPE is below its historical average, the market is presumed to be undervalued. Both the numerator and denominator of CAPE must be inflation adjusted and be measured in the same base year; in which case, they can also be said to be real numbers.

Video covering this content is available online.

EXAMPLE: Using CAPE

An analyst determines the average of the last 10 years of earnings of the S&P Index to be 90, the index price is 2,250. The analyst deflates the index price to an earlier base year and finds it to be 2,150. When all 10 years earnings are placed in that same base year, their average is 97. The analyst next determines the historically average CAPE of the index is 23.7. Using the CAPE model, **determine** if the market is over- or undervalued. **Show** your calculations.

Answer:

Current CAPE: 2,150 / 97 = 22.2

This is below the average CAPE of 23.7, indicating the market is undervalued.

PROFESSOR'S NOTE

The choice of base year used in calculating CAPE is arbitrary and does not affect the calculated value of CAPE. For example, you could restate earnings from past years in real terms by multiplying the earnings figure by the ratio of today's CPI to the relevant year CPI. Assume earnings per share for 2008 were \$3.00, and you wish to restate them as of June 2010 (i.e., restate them in June 2010 dollars). You would multiply December 2008 EPS by the ratio of 217.965 to 210.228, the CPIs for June 2010 and December 2008, respectively.

$$\begin{aligned}\text{restated 2008 earnings} &= \text{nominal 2008 earnings} \times \left(\frac{\text{CPI}_{6\,/\,2010}}{\text{CPI}_{12\,/\,2008}}\right)\\ &= \$3.00 \times \left(\frac{217.965}{210.228}\right) = \$3.00 \times 1.036803 = \$3.11\end{aligned}$$

Suppose after restating all of the past 10 years of earnings to June 2010 and comparing the average adjusted earnings to the June 2010 index price, the current CAPE is 50 / 2.50 = 20.

Now suppose the CAPE numerator and denominator had been stated in December 2008 terms; both the numerator and denominator would be reduced by the same 1½ years of inflation (inflation from December 2008 to June 2010) and the current CAPE ratio will still be 20.

For the Exam: When answering questions about CAPE, important considerations include:

- By restating earnings and prices according to CPI, it considers the effects of inflation.
- By using 10-year average earnings, it captures the effects of business cycles, but by its nature it is backward-looking.
- It does not consider the effects of changes in accounting rules or methods.
- Empirical studies have found that very high or low CAPE ratios have persisted, limiting its usefulness in forming short-run expectations.

MODULE 17.7: Q-MODELS

Tobin's q compares the current market value of a company to the replacement cost of its assets. The theoretical value of Tobin's q is 1.0. If the current Tobin's q is above (below) 1.0 the firm's stock is presumed to be overpriced (underpriced).

Video covering this content is available online.

The **equity q** focuses directly on equity values. It compares the aggregate market value of the firm's equity to the replacement value of the firm's net worth (i.e., net assets). Again, the neutral value of the ratio is 1.0.

Both ratios are considered *mean-reverting*. A q value for either above 1.0 would be expected to fall as the overvalued stock price declines. Using the opposite argument, a value less than 1.0 suggests the undervalued stock should rise.

$$\text{Tobin's q} = \frac{\text{asset market value}}{\text{asset replacement cost}} = \frac{\text{market value of debt + equity}}{\text{asset replacement cost}}$$

$$\text{equity q} = \frac{\text{market value of equity}}{\text{replacement value of net worth}} = \frac{\#\text{ outstanding shares} \times \text{price per share}}{\text{replacement value of assets} - \text{liabilities}}$$

Both ratios have some long term value as indicators. However, it is difficult to estimate replacement values and high or low q ratios can persist for long periods of time; in other words, the expected stock price correction may not quickly occur.

MODULE QUIZ 17.4, 17.5, 17.6, 17.7

To best evaluate your performance, enter your quiz answers online.

1. While analyzing potential global investments, Gretchen Fenledder, CFA, gathered the data in Table A on emerging Equity Market Index Y:

Table A: Economic Data for Index Y*

Last dividend (D0)	150
Forecast earnings per share	600
Current and sustainable long-term growth rate	2.5%
Required return	8.5%
Forward operating yield (E/P)	6.0%

* Yield on 10-year government bond = 6%

Based on the data in Table A:

a. **Determine** the intrinsic price level of the index.

b. **Determine** whether the market is over- or under-valued using the Fed model.

2. **Compare** Tobin's q and the equity q for market valuation. **Provide** and **explain** one strength and one weakness of each.

3. **Explain** three weaknesses of the Fed model.

4. **Describe** the Yardeni model. Referring to specific variables in each, **explain** how the Yardeni and Fed models could arrive at different conclusions about the relative value of an equity market.

KEY CONCEPTS

LOS 17.a

The Cobb-Douglas function (CD) relates real economic output to capital stock and labor as well as factor productivity:

Y = AKαLβ

By applying natural logs and making other assumptions, it can be restated to predict changes in output:

$$\frac{\Delta \mathrm{Y}}{\mathrm{Y}} \cong \frac{\Delta \mathrm{A}}{\mathrm{A}} + \alpha \frac{\Delta \mathrm{K}}{\mathrm{K}} + (1 - \alpha) \frac{\Delta \mathrm{L}}{\mathrm{L}}$$

$$\text{Solow residual} = \quad \mathrm{TFP} = \frac{\mathrm{A}}{\mathrm{A}} \cong \frac{\mathrm{Y}}{\mathrm{Y}} - \alpha \frac{\mathrm{K}}{\mathrm{K}} - (1 - \alpha) \frac{\mathrm{L}}{\mathrm{L}}$$

where:

A = total factor productivity (TFP)

K = capital stock

L = labor input

α = output elasticity of K; the change in Y for a 1-unit change in K (0 < α < 1)

β = output elasticity of L; the change in Y for a 1-unit change in L (α + β = 1)

LOS 17.b

Once we have estimated the growth equation, %ΔY = %ΔA + α %ΔK + (1 − α) %ΔL, we can use the historical growth of capital and labor, along with the estimates of output elasticities for labor and capital, to decompose the growth of GDP in order to evaluate the relative effects of labor growth, capital accumulation, and increases in factor productivity on economic growth.

LOS 17.c, 17.d

We assume the growth rate in corporate earnings and dividends is the same as the growth rate in gross domestic product (GDP). If an economy is expected to grow at a particularly high rate of growth for a number of years and then revert to a sustainable growth rate, we apply the H-model:

$$V_0 = \frac{D_0}{r - g_L}\left[(1 + g_L) + \frac{N}{2}(g_S - g_L)\right]$$

When growth is assumed constant, we can use the constant growth dividend discount model:

$$V_0 = \frac{D_1}{r - \bar{g}} = \frac{D_0\,(1 + \bar{g})}{r - \bar{g}}$$

LOS 17.e

In a top-down forecast, the analyst utilizes macroeconomic factors to estimate the performance of market-wide indicators. Successive steps include identifying sectors in the market and then individual securities that will perform best, given market expectations.

In a bottom-up forecast, the analyst first takes a microeconomic perspective by focusing on the fundamentals of individual firms. For a macro forecast, the analyst can then aggregate the expected performance of individual securities.

To determine which to use, determine the manager's focus. For example, a macro hedge fund manager who focuses on optimal allocations of global markets or currencies would use a purely top-down approach. An active manager who buys and sells individual securities to capture short-term pricing inefficiency would utilize a bottom-up approach.

LOS 17.f, 17.g

The Fed model assumes the yield on long-term U.S. Treasuries should be the same as the expected operating earnings yield on the S&P 500. When the S&P 500 earnings yield is higher (lower) than the Treasury yield, the interpretation is that the index is too low (high).

The Fed model:

- Does not consider the equity risk premium.
- Ignores growth in earnings.
- Compares a real variable (index level) to a nominal variable (Treasury yield).

The Yardeni model assumes investors value total earnings rather than dividends:

$$P_0 = \frac{E_1}{r - g} \Rightarrow \frac{E_1}{P_0} = Y_B - d\,(LTEG)$$

Important considerations include:

- It uses the yield on A-rated corporate debt as the equity risk premium.
- The risk premium used is actually a measure of default risk, not a true measure of equity risk.
- It relies on an estimate of the value investors place on earnings growth (*d*), which is assumed to be constant over time.

- The growth rate used in the model (LTEG) might not be a fair estimate of long-term sustainable growth.

CAPE: The numerator is the value of the price index, and the denominator is the average of the previous ten years' reported earnings. Both are adjusted for inflation using the consumer price index.

Important considerations include:

- It considers the effects of inflation.
- It captures the effects of business cycles.
- Current or expected earnings could provide more useful information.
- It does not consider the effects of changes in accounting rules or methods.
- Very high or low CAPE ratios can persist, limiting its usefulness in forming short-run expectations.

$$\text{Tobin's q} = \frac{\text{market value of debt+equity}}{\text{asset replacement cost}}$$

$$\text{equity q} = \frac{\text{market value of equity}}{\text{replacement value of assets}-\text{liabilities}}$$

Important considerations include:

- Both ratios are mean-reverting.
- Both have demonstrated a negative relationship with equity returns.
- Replacement costs can be difficult to estimate.
- Very high or low ratios can persist, limiting their usefulness in forming short-run expectations.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 17.1

1. a. $\frac{\Delta Y}{Y} \cong \frac{\Delta A}{A} + \alpha \frac{\Delta K}{K} + (1-\alpha)\frac{\Delta L}{L}$

   $\frac{\Delta Y}{Y} = \%\text{ change in real output } (\%\Delta Y)\text{: growth in GDP}$

   $\frac{\Delta A}{A} = \%\text{ change in total factor productivity } (\%\Delta TFP)$

   $\frac{\Delta K}{K} = \%\text{ change in capital stock } (\%\Delta K)$

   $\frac{\Delta L}{L} = \%\text{ change in labor } (\%\Delta L)$

   α and $(1 – \alpha)$ are the weights for capital and labor in the economy.

   b. Expected growth in total factor productivity: 1.5%

   Expected growth in labor: 3.0%

   Expected growth in capital stock, $\alpha = 0.6$: 2.2%

$$\frac{\Delta Y}{Y} \cong \frac{\Delta A}{A} + \alpha \frac{\Delta K}{K} + (1-\alpha)\frac{\Delta L}{L}$$

   $\frac{Y}{Y} \cong 1.5\% + 0.6(2.2\%) + 0.4(3.0\%) = 4.02\%$

   c. The Solow residual refers to using Cobb-Douglas and historical or estimated change in the real economic output, expected changes in labor and capital, and the economy's elasticities of capital and labor to then solve for TFP. It is useful because it is difficult to otherwise estimate TFP.

   An economy's TFP can change over time due to the following factors:

   - Better technology improves TFP.
   - More restrictions on capital flows and labor mobility reduce TFP.
   - More trade restrictions reduce TFP.
   - Changing laws that impose costs or increase uncertainty reduce TFP.
   - Inefficient division of labor reduces TFP.

- Depleting/discovering natural resources reduces/increases TFP.

  (LOS 17.a)

2.

Factor	Effect on Economic Growth (circle one)	Explanation
i. Slowing growth of the population.	Decrease	Increase in labor input slowing.
ii. Decrease in the government- mandated retirement age.	Decrease	Assuming it induces individuals to retire earlier, reduction in labor input.
iii. Relaxation of import duties and other trade restrictions.	Increase	Increased international competition; falling prices.
iv. Corporate tax relief to encourage technological innovation.	Increase	Short-term depression on growth with increased costs and retooling but increased in long-run due to technological improvements

(Module 17.3, LOS 17.b)

Module Quiz 17.2, 17.3

1. In a top-down forecast, the analyst utilizes macroeconomic factors to estimate the performance of market-wide indicators, such as the S&P 500. Successive steps include identifying sectors in the market that will perform best given market expectations.

   The analyst starts by comparing the relative values of various market composites to their historical patterns to identify any that appear to be under- or over-priced. Next, the analyst attempts to identify any momentum in the indices. In the final macro-analysis, the analyst compares the expected performance of the indices to general asset classes, such as equities, bonds, and alternatives to identify which class of assets will be expected to under- or out-perform.

   In a bottom-up forecast, the analyst takes a microeconomic perspective by focusing on the fundamentals of individual firms. The analyst starts the bottom-up analysis by looking at an individual firm's product or service development relative to the rest of the industry. The analyst should assess the firm's management and its willingness and ability to adopt the technology necessary to grow or even maintain its standing in the industry. Given the analyst's expectations for the firm, the analyst uses some form of cash flow analysis to determine the firm's investment potential (i.e., expected return).

   The method used depends on the analyst's strategy. A manager who utilizes a long-short, market neutral strategy would probably pursue a purely bottom-up analysis. Another manager's strategy could focus on allocating among markets or industries. In these cases, there is little need for the top-down manager to go any lower or the bottom-up manager to go any higher than the first step.

When approaching or leaving recessions, manager expectations can be biased. It would be wise in these situations for the bottom-up analyst to also utilize a top-down approach to confirm earnings estimates. (Module 17.3, LOS 17.e)

2.

Scenario	**Top-Down or Bottom-Up (circle one)**	**Justification**
A global macro-hedge fund takes large positions in foreign currencies.	Top-down	With their focus on the relative values of global currencies, there is no need for the hedge fund to focus on individual firms.
Portfolio manager Active A employs a market neutral strategy and adds market exposure with equity futures.	Bottom-up	Active A's primary strategy is market neutral. They generate alpha by going long and short in individual stocks expected to out- or under-perform in weights that will drive the ultimate market exposure (systematic risk) to zero. The selection of equity futures is a passive approach to adding market exposure.
Active Investors, LLP, advertises that they earn alpha through stock selection.	Bottom-up	Stock selection represents the stereotypical bottom-up approach. Because they generate alpha through stock selection, the focus is on the valuation of individual stocks, not macrowide indices or factors.

(LOS 17.e)

Module Quiz 17.4, 17.5, 17.6, 17.7

Last dividend (D_0)	150
Current and sustainable long-term growth rate	2.5%
Required return	8.5%
Forward operating yield (E/P)	6.0%
*Yield on 10-year government bond = 6%	

1.

a. We are provided with the long-term sustainable growth rate, the required return, and the current dividend, so we know to use the constant growth dividend discount model to determine the intrinsic value of the index:

$$P_0 = \frac{D_1}{r-g} = \frac{D_0(1+g)}{r-g} = \frac{150(1.025)}{0.085-0.025} = \frac{153.75}{0.06} = 2{,}562.50$$

b. The Fed model compares the operating yield on the index to the yield in the intermediate-term government bond:

Fed model ratio = earnings yield / government yield = 0.06 / 0.06 = 1.0

Based on expected earnings, the market appears to be correctly priced.

If the Fed model produces a ratio greater than 1.0, the earnings yield is considered too high (earnings are high relative to prices), indicating that the market is currently undervalued and would be expected to rise. If the ratio is less than 1.0, the earnings yield is too low, and the market is deemed to be over-valued. (Module 17.4, LOS 17.c, 17.d, 17.f, 17.g)

2. Tobin’s q compares the current market value of a company to the replacement cost of its assets. The theoretical value of Tobin’s q is 1.0. If the current Tobin’s q is above (below) 1.0, the firm’s stock is presumed to be overpriced (underpriced).

   The equity q compares the current market value of the firm’s equity to the replacement value of the firm’s net worth (i.e., net assets). Again, the expected value of the ratio is 1.0.

   Both ratios are considered mean-reverting. With a q value above 1.0, stock price should fall and below 1.0, stock price should rise.

$$\text{Tobin's q} = \frac{\text{asset market value}}{\text{asset replacement cost}} = \frac{\text{market value of debt} + \text{equity}}{\text{asset replacement cost}}$$

$$\text{equity q} = \frac{\text{market value of equity}}{\text{replacement value of net worth}} = \frac{\text{\# outstanding shares} \times \text{price per share}}{\text{replacement value of assets} - \text{liabilities}}$$

   Strengths of both models include:

   - Both are mean-reverting, so they are easy to use.
   - Both have usefulness as demonstrated by a negative relationship with equity returns. Higher (lower) ratios have forecasted lower (higher) equity returns.

   Weaknesses include:

   - Replacement costs can be difficult to estimate.
   - Empirical studies have found that very high or low ratios have persisted for both, limiting their usefulness in forming short-run expectations.

   (Module 17.7, LOS 17.f, 17.g)

3. The Fed model does not consider the equity risk premium, it ignores growth in earnings, and it compares a real variable (index level) to a nominal variable (Treasury yield).

   Ignores growth in earnings: It compares the earnings yield on the market index (only a portion of the total return on the index) to the total expected return on the Treasury security. It does not include the growth portion of the expected index return.

Real and nominal variables: The yield on the Treasury security includes an inflation premium while earnings are considered a real variable. (Module 17.4, LOS 17.f, 17.g)

4. The Yardeni model is based on the constant growth dividend discount model (CGM), stated in terms of earnings rather than dividends:

$$P_0 = \frac{E_1}{r-g}$$

The earnings yield must be the difference between the required return on equity and expected long-term growth:

$$P_0 = \frac{E_1}{r-g} \Rightarrow r = \frac{E_1}{P_0} + g \Rightarrow \frac{E_1}{P_0} = r - g$$

The model uses the yield on A-rated corporate bonds as the required return on equity. Instead of the long-term growth assumed in the CGM, Yardeni uses a 5-year growth forecast for the S&P 500.

$$\frac{E_1}{P_0} = Y_B - d(\text{LTEG})$$

where:
Y_B = yield on A-rated corporate bonds
d = a weighting factor for the importance of earnings growth; historically around 0.10

If the current market earnings yield is high compared to the Yardeni earnings yield, equities are underpriced. Equities would be expected to rise in value:

$$\text{if } \frac{E_1}{P_0} - [Y_B - d(\text{LTEG})] > 0 \Rightarrow \text{market is under-valued}$$

$$\text{if } \frac{E_1}{P_0} - [Y_B - d(\text{LTEG})] < 0 \Rightarrow \text{market is over-valued}$$

The Fed model assumes the expected operating earnings yield on the S&P 500 should be same as the yield on long-term U.S. Treasuries:

$$\text{Fed model ratio} = \frac{\text{S\&P earnings yield}}{\text{Treasury yield}}$$

If the S&P 500 earnings yield is higher than the Treasury yield, the index value is low relative to earnings, and the market should increase in value. If the S&P 500 earnings yield is lower than the Treasury yield, the index value is high relative to earnings, and the market should drop in value.

In order to discuss circumstances where the Fed and Yardeni models could yield different conclusions about market valuation, we reproduce them as ratios and see that both contain the expected S&P earnings yield in the numerator:

$$\text{Fed model ratio} = \frac{\text{S\&P earnings yield}}{\text{Treasury yield}}$$

$$\text{Yardeni ratio} = \frac{\text{S\&P earnings yield}}{Y_B - d(\text{LTEG})}$$

In situations where [Y_B − d(LTEG)] is dramatically different from the Treasury yield, the two ratios can yield conflicting conclusions. For example, YB might be historically high while interest rates are historically low (i.e., interest rates are low but risk aversion is high, making the risk premium on A-rated bonds high). In that case, the resulting Yardeni ratio could be less than 1.0 (indicating the market is over-valued) while the Fed model is greater than 1.0 (indicating the market is undervalued). (Module 17.5, LOS 17.f, 17.g)

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1. Terminology used throughout this topic review is industry convention as presented in Reading 17 of the 2019 Level III CFA exam curriculum.

2. LTEG is the 5-year consensus growth forecast provided by Thomson Financial.

TOPIC ASSESSMENT: ECONOMIC ANALYSIS

Use the following information for Questions 1 through 6.

Economist James Jones prepares economic forecasts for Global Bancorp, a large U.S.-based investment bank. Recent market volatility and political changes have many investors worried about the future. Jones is preparing market forecasts and as a first step plans to look at several approaches to the task.

He begins by looking at the shape of the yield curve, which is flat. He also considers the Taylor rule, which he has found useful for predicting changes in central bank policy. He gathers the following economic data, which includes his predictions for inflation and economic growth:

Current short-term rate target:	4.15%
Policy neutral rate:	3.57%
Target inflation rate:	2.00%
Expected inflation rate:	0.60%
Expected GDP growth, current year:	3.84%
Target GDP growth rate:	3.27%

Jones next considers the business cycle. He forecast declining consumer confidence and corporate profits, concluding that we are in the slowdown phase.

Finally, he turns to an analysis of Venvakia, an emerging market that several of Bankcorp's managers are interested in adding to their global portfolio. In his research, Jones learns:

- Venvakia's population is rising at a 3.2% rate, while the rate of participation in the labor force is rising at a 0.9% clip. Over the last year, GDP increased 4.5%. The world's GDP rose 3%. In an effort to boost growth, the government funds highquality colleges to improve the versatility of the Venvakian workforce.
- Venvakia's government is uncommonly steady relative to that of other countries in its part of the world. The country's tax rate is quite low, and there are very few deductions allowed for either consumers or businesses. Long-term growth in capital spending is likely to average 2%, with a weight in the economy of 30%. Factor productivity is expected to average 1.4%. The inflation rate is currently 1.3% and expected to stay at that level this year. Consumer consumption is expected to rise 4.4% this year, and an expected appreciation in Venvakian currency should boost buying power.
- Except for inflation, all of the data is in real terms.

Jones is not yet ready to form any final conclusions. He first wants to assess each of these approaches independent of the others.

1. Based on the flat shape of the yield curve, what is the *most likely* current blend of fiscal and monetary policy?

	Monetary policy	Fiscal policy
A.	Restrictive	Expansive
B.	Expansive	Restrictive
C.	Expansive	Expansive

2. Based on the Taylor rule and the data collected by Jones (including his inflation and growth forecasts), he will *most likely* predict the next central bank action is to:
   A. decrease interest rates.
   B. increase interest rates.
   C. make no change.

3. Based on Jones' assessment of the business cycle, he will *most likely* predict:
   A. cash will outperform bonds.
   B. bonds will outperform stocks.
   C. stocks will outperform cash.

4. Again, based only on Jones' assessment of the business cycle, he will *most likely*:
   A. increase duration.
   B. decrease duration.
   C. overweight cyclical stocks.

5. Based on Cobb-Douglas and Jones' forecasts, Venvakia's long-term economic growth forecast is *closest* to:
   A. 3%.
   B. 4%.
   C. 5%.

6. Based on all of Jones' information about Venvakian, he would *most likely* conclude its stock market is:
   A. attractive due to the high rate of population growth.
   B. attractive because expected growth is well above global average growth.
   C. unattractive in the short run because reversion to mean indicates growth will revert towards the world market growth rate.

TOPIC ASSESSMENT ANSWERS: ECONOMIC ANALYSIS

1. **A** The flat yield curve is generally associated with a mix of expansive and contractionary policies, specifically expansive fiscal and restrictive monetary policy. (Study Session 8, Module 16.5, LOS 16.i)

2. **A** Using Jones' forecasts and other data, he would calculate the target rate as:

   neutral rate + 0.5 × (expected GDP – GDP trend) + 0.5 × (expected inflation – target inflation)

   $3.57\% + 0.5 \times (3.84\% - 3.27\%) + 0.5 \times (0.6\% - 2.0\%) = 3.15\%.$

   The current central bank target is higher at 4.15%, so the most likely change is to lower interest rates. (Study Session 8, Module 16.5, LOS 16.h)

3. **B** In the slowdown, short- and long-term rates have likely peaked and at some point should start to decline. Declines in long-term rates will lead to increasing bond prices and good performance. The stock market is likely to continue to decline as economic recovery is still well in the future. The clearest conclusion would be bonds outperform stocks. If bond prices start increasing, bonds are likely to outperform cash. Stocks are simply the worst choice at this stage. (Study Session 8, Module 16.4, LOS 16.f, 16.g)

4. **A** Based on the discussion in Question 3 and the expectation that long-term interest rates can start to decline, Jones will want to increase duration to magnify the increases in bond price. Cyclical stocks are likely to do even worse than the general stock market. (Study Session 8, Module 16.4, LOS 16.f, 16.g)

5. **C** Cobb-Douglas bases the long-term forecast on total factor productivity, population growth and labor market participation, capital input spending, and weights. Cobb-Douglas uses data in real terms and that was provided.

   $1.4 + (3.2 + 0.9)(0.7) + 2.0(0.3) = 1.4 + 2.87 + 0.6 = 4.87\%$

   (Study Session 8, Module 17.1, LOS 17.a)

6. **B** First, see the Cobb-Douglas long-term growth estimate from Question 5, which indicates good long-term real growth. Second, see the various government policies that are consistent with favorable economic growth, for example, investment in college education, low taxes, and controlled modest inflation. Third, the appreciation in the currency will boost return for foreign investors in Venvakian market.

   The high population growth is not a good answer as it has mixed effects. It does boost growth in labor and therefore potential economic growth. But it also necessitates higher economic growth to keep up with population growth and boost per capita standard of living. The reversion to mean argument is just plain wrong. Reversion does not assign any specific time period. The argument that emerging market growth will eventually converge to world market level is not a reason to avoid emerging markets. The integration process can take many years and is associated with attractive investment returns as capital flows into the market, presuming integration is successful. (Study Session 8, Module 17.1, LOS 17.b)

The following is a review of the Asset Allocation and Related Decisions in Portfolio Management (1) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #18.

READING 18: INTRODUCTION TO ASSET ALLOCATION

Study Session 9

EXAM FOCUS

Strategic asset allocation is often considered the most important decision in the portfolio management process. This reading provides a big picture overview of asset allocation and its relationship to the investor's objectives and constraints. It discusses issues related to an investor's overall financial situation and use of an economic balance sheet. It also provides an overview of three major asset allocation approaches (asset-only, liability-relative, and goals-based), passive versus active approaches to implementing the asset allocation, and key issues to consider when rebalancing the asset allocation.

MODULE 18.1: ECONOMIC BALANCE SHEET

LOS 18.a: Prepare an economic balance sheet for a client and interpret its implications for asset allocation.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 181

The traditional accounting balance sheet encompasses an organization's assets, liabilities, and owner's equity. It is used by accountants to illustrate the financial position of an organization. In contrast, an **economic balance sheet** contains an organization's financial assets and liabilities, as well as any nonfinancial assets and liabilities that are applicable to the asset allocation decision. These nonfinancial assets and liabilities are referred to as **extended portfolio assets and liabilities** because they are not included on traditional balance sheets.

Investors making appropriate asset allocation decisions should recognize assets and liabilities in both the financial portfolio and the extended portfolio. Extended portfolio assets may include the present value of expected earnings (i.e., human capital) and the present value of pension income (for individual investors) as well as the present value of expected intellectual property royalties and underground mineral resources (for institutional investors). Extended portfolio liabilities may include the present value of expected consumption (for individual investors) and the present value of expected foundation payouts (for institutional investors). An example of an economic balance sheet for an institutional investor can be seen in Figure 18.1.

Figure 18.1: Economic Balance Sheet

Assets		**Liabilities and Net Worth**	
Financial Assets		*Financial Liabilities*	
Domestic equity	400	Short-term borrowing	100
Real estate	250	Mortgage obligations	200
Extended Assets		*Extended Liabilities*	
PV of expected royalties	150	PV of expected payouts	300
		Net Worth	
		Economic assets − Economic liabilities	200
Total	800	**Total**	800

A practical application of an investment that includes human capital is a life-cycle balanced fund (i.e., target retirement fund). These funds consider the changing levels of human capital and financial capital for an individual investor over time. When an individual enters the workforce, human capital will be much greater than financial capital. However, as the individual ages, financial capital will begin to outweigh human capital because the present value of expected future earnings will gradually decline. At retirement, an individual's total wealth will be made up of financial capital.

Life-cycle balanced funds adjust asset allocations for individual investors over time by taking into account both financial assets and extended portfolio assets. For example, at age 25, a target-date fund may be invested in 85% equity and 15% bonds. This considers the fact that human capital has significant bond-like characteristics. As the investor ages, the equity/bond mix will increase its allocation to bonds as human capital decreases. At retirement (e.g., age 65), the target-date fund may be invested in an asset mix that is closer to 50% equity and 50% bonds.

MODULE 18.2: APPROACHES TO ASSET ALLOCATION

LOS 18.b: Compare the investment objectives of asset-only, liability-relative, and goals-based asset allocation approaches.

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Video covering this content is available online.

There are three types of asset allocation approaches: (1) asset-only, (2) liability-relative, and (3) goals-based. In this section, we will discuss the investment objectives of each approach. These asset allocation approaches attempt to match investors' goals with their optimal level of risk.

Asset-only approaches make asset allocation decisions based solely on the investor's assets. An example of an asset-only approach is *mean-variance optimization* (MVO), which incorporates the expected returns, volatility, and correlations of asset classes. The investment objective for this approach is to maximize the expected return per unit of risk (e.g., maximize the Sharpe ratio). The chosen investments should consider investor constraints (stated in the IPS) as well as investor risk tolerance.

Liability-relative approaches involve asset allocation decisions based on funding liabilities, with the objective of paying liabilities when they come due. An example of a liability-relative approach is *surplus optimization*, which is based on principles from mean-variance asset allocation. The surplus is computed as the investor assets value minus the present value of investor liabilities. Modeling liabilities may be achieved by shorting an amount of bonds that matches the duration and present value of liabilities. Liabilities may also be modeled by creating a portfolio designed to hedge the liabilities. Asset allocation focused on funding liabilities is also known as *liability-driven investing* (LDI).

Goals-based approaches are geared toward asset allocations for subportfolios, which help individuals or families achieve lifestyle and aspirational financial objectives. For example, goals could involve maintaining a current lifestyle or donating money to a university at some point in the future. In order to achieve the stated goals, it is necessary to specify the type of cash flows needed (e.g., even, uneven, or bullet payment), the time horizon(s), and the level of risk tolerance in terms of the probability of attaining a certain goal. Each sub-portfolio will have a unique asset allocation designed to meet the stated goals. Summing these asset allocations will produce the investor's overall portfolio strategic asset allocation. Asset allocation focused on investor's goals is also known as *goals-based investing* (GBI).

Both liability-relative and goals-based asset allocation approaches are based on meeting liabilities. The main difference is that liability-relative approaches focus on the liabilities of institutional investors while goals-based approaches focus on the liabilities of individual investors. Institutional investors have legal obligations or debts, whereas individual investors wish to meet specific lifestyle goals. This suggests that penalties for not meeting liabilities are much higher for liability-relative approaches. In addition, the type and number of obligations will differ between approaches. Institutional investor obligations are constant and numerous (e.g., life insurance and pension benefit payments are the future liabilities of insurance companies and defined benefit pension plans), while individual investor goals are much less predictable. This suggests that institutional liabilities can be more confidently forecasted since the average of a large number of obligations is more certain than the uncertain time horizon needs of one individual investor.

RELEVANT RISK CONCEPTS

LOS 18.c: Contrast concepts of risk relevant to asset-only, liability-relative, and goals-based asset allocation approaches.

CFA® Program Curriculum, Volume 3, page 187

Risk concepts associated with asset-only approaches focus on asset class risk as well as constructing effective asset class combinations. The relevant risk measure for MVO, the most popular asset-only approach, is the standard deviation of portfolio returns, which incorporates asset class volatilities and asset class return correlations. Other risk sensitivities, such as relative risk and downside risk, can also be measured with a mean-variance framework. For example, the risk relative to a benchmark can be modeled with tracking error, and downside risk can be modeled with value at risk (VAR), semivariance, or maximum drawdown.

Monte Carlo simulation is a statistical modeling tool often used to complement MVO. For example, a manager could begin by selecting several optimal portfolios using MVO that have acceptable risk and return for the client and then use Monte Carlo simulation to generate multiple simulated paths, which display how these portfolios would perform over time. This action would provide useful information on downside risk when portfolios encounter a market stress scenario. These results can then be used to refine asset allocation decisions.

Risk concepts associated with liability-relative approaches focus on not having enough assets to pay liabilities when they come due. The volatility of contributions used for funding liabilities is also a risk. The standard deviation of the surplus may be used as the relevant risk measure. In general, the differences between asset and liability characteristics (e.g., size, sensitivity to interest rate changes) are the main drivers of risk for liability-relative asset allocation approaches.

Risk concepts associated with goals-based approaches focus on the risk of not being able to achieve the stated financial goals. If an investor has multiple goals, then the risks will encompass multiple future time periods. Thus, portfolio risk under a goals-based approach is the weighted sum of the risk that is attached to each goal.

MODULE QUIZ 18.1, 18.2

To best evaluate your performance, enter your quiz answers online.

1. Which of the following investments would *most likely* be part of the extended portfolio of the assets and liabilities sections on an economic balance sheet?
   A. Human capital.
   B. Financial assets.
   C. Financial liabilities.
2. Which of the following asset allocation approaches is focused on achieving lifestyle and aspirational financial objectives?
   A. Asset-only approach.
   B. Goals-based approach.
   C. Liability-relative approach.
3. The asset allocation approach that is concerned with the risk of not having enough assets to pay liabilities when they come due is known as:
   A. asset-only.
   B. goals-based.
   C. liability-relative.

MODULE 18.3: ALLOCATION BY ASSET CLASS OR RISK FACTOR

LOS 18.d: Explain how asset classes are used to represent exposures to systematic risk and discuss criteria for asset class specification.

 Video covering this content is available online.

An asset class is a group of assets that have similar investment characteristics. Each asset class has its own quantifiable systematic risk, and strategic asset allocation is a conscious effort to gain the desired exposure to systematic risk via specific weights to individual asset classes. Exposure to specific asset classes in specific proportions enables portfolio managers to effectively monitor and control their systematic risk exposure. In other words, strategic asset allocation reflects the investor's desired systematic risk exposure.

In a generic sense, there are three categories of "super asset classes": (1) capital assets, which provide a continuous source of value (e.g., dividends), (2) consumable or transformable assets, which can be consumed or transformed into a source of value (e.g., commodities), and (3) store-of-value assets, which provide value when exchanged or sold (e.g., currencies, art).

For the purposes of asset allocation, it is necessary to define asset classes. With this information, investors and managers can better distinguish among asset classes when developing an investment strategy. For example, combining emerging market equities and domestic equities into a single asset class labeled *equities*would be appropriate only from a general description standpoint; their risk and return characteristics are obviously different. The following criteria can be used to specify asset classes:

高内聚
- *Assets in an asset class should have similar attributes from both a descriptive and statistical perspective.*

不交叉
- *Assets cannot be classified into more than one asset class.* If it can be legitimately argued that assets can be placed in more than one class, the descriptions of the classes are too vague.

低耦合
- *Asset classes should not be highly correlated in order to provide desired diversification.* A high correlation between classes would indicate that the classes are related from a risk and return standpoint. This would defeat the purpose of holding separate classes in an allocation.

全覆盖
- *Asset classes should cover all possible investable assets*. This factor not only increases the set of investable assets, but also pushes up the efficient frontier (i.e., increases expected return at all levels of risk).

流动性
- *Asset classes should contain a sufficiently large percentage of liquid assets*. If liquidity and transaction costs are significant, the asset class may not be ideal for investment because it lacks sufficient liquidity.

Some well-accepted asset classes include domestic equity, domestic fixed income, global equity, global fixed income, cash and equivalents, and alternative investments, which may be further divided into classes such as real estate, private equity, et cetera.

Too much granularity (number of subdivisions of classes used) in the asset allocation can make it difficult to construct an optimal portfolio based on an investor's required level of return and risk. Within each asset class, sub–asset classes can be created that are less distinct than their corresponding broad asset classes. For example, Figure 18.2 shows how the asset class of global equity can be broken down into U.S. and non–U.S.

equity securities. The sub–asset class of U.S. equities can be further segmented into large-cap and small-cap equities.

Figure 18.2: Asset Classes and Sub–Asset Classes

Asset Classes	**Sub–Asset Classes**	
Global equity	U.S. equities	Large-cap equities
		Small-cap equities
	Non–U.S. equities	Developed countries
		Emerging countries
Global fixed income	U.S. debt	Investment-grade debt
		High-yield debt
	Non–U.S. debt	Developed countries
		Emerging countries

Strategic asset allocation should focus primarily on the asset class divisions that have distinctly different characteristics and will provide diversification (i.e., global equity versus fixed income). As you move down in granularity (level of subdivision) the differential between classes will shrink (i.e., U.S. and non–U.S. equity will be less distinctly different from each other than global equity versus global fixed income). However, when progressing from strategic asset allocation to policy implementation and tactical asset allocation, decisions may focus more on the sub–asset classes.

COMMON RISK FACTORS

LOS 18.e: Explain the use of risk factors in asset allocation and their relation to traditional asset class–based approaches.

CFA® Program Curriculum, Volume 3, page 193

Asset classes have traditionally been used as units of analysis when making asset allocation decisions. This process is known as *asset-based asset allocation*. For example, MVO incorporates expected return, volatility, and correlation estimates from the selected asset classes. However, using asset classes in this fashion may be problematic due to overlapping risk factors among asset classes.

An investor selects asset classes based on their desired exposure to common risk factors. Examples of risk factors include volatility, liquidity, inflation, interest rates, duration, foreign exchange, and default risk. As mentioned, risk factor exposures may overlap across multiple asset classes. For example, the asset classes of domestic equity and domestic fixed income will both share exposures to foreign exchange (in the sense that changes in value of the domestic currency can affect profitability of issuers and return on investments in their debt and equity), liquidity, and volatility risk factors. Examining these overlapping risk factors can help investors identify the correlations among asset classes.

Due to overlapping risk factors, it may be insightful to focus on risk factors rather than traditional asset classes as units of analysis. This is accomplished by identifying the risk factors as well as the desired exposure to each factor. Multifactor models can then be used for asset allocation by creating factor portfolios, which isolate systematic risk exposures (i.e., nondiversifiable risks). This process is known as *factor-based asset allocation*.

This does not mean risk factor analysis is inherently more useful. It has its own limitations. For example investors may not be able to directly invest in all risk factors. But risk factor analysis may offer additional insight, and risk factors often correspond to expected return premiums. Some risk factors may be investable with spread positions, which take long and short positions in assets, or by using derivatives. For example, to isolate inflation risk, an investor would go long Treasuries (which reflect compensation for consensus-expected inflation) and short inflation-linked bonds (which will adjust and compensate for actual future inflation); or an investor would invest in volatility index (VIX) futures with payoffs based on actual change in volatility.

STRATEGIC ASSET ALLOCATION

LOS 18.f: Select and justify an asset allocation based on an investor's objectives and constraints.

CFA® Program Curriculum, Volume 3, page 194

Strategic asset allocation combines capital market expectations (expected return, volatility, and correlation) with an investor's risk, return, and investment constraints (from the IPS). Strategic asset allocation is long term in nature, and the weights are called *targets* and the portfolio represented by the strategic asset allocation is a *policy portfolio*, *target portfolio*, or *benchmark*.

Most quantitative approaches to asset allocation are based on utility theory. This framework uses a utility function that incorporates investor risk aversion. Expected utility for a certain asset allocation is determined with a distribution of ending wealth values, which is based on asset class weights, asset class returns, and beginning wealth values. The maximum level of utility, subject to asset class constraints, will represent the investor's optimal asset association given the investment horizon.

Selecting and justifying a strategic asset allocation based on investor objectives and constraints is outlined in the following steps:

1. *Determine investor objectives*. Relevant questions include the following: How will the investor use these assets? What would the investor like to achieve? What are the investor liabilities and goals? How should the objectives be measured?
2. *Determine investor tolerance for risk*. Relevant questions include the following: What are the investor's sensitivities to risk? How should risk be measured in terms of asset allocation?

3. *Determine investor time horizon(s).* Relevant questions include the following: What investment horizon should be used to evaluate investor objectives? What investment horizon should be used to evaluate investor risk tolerance?
4. *Determine investor constraints.* Relevant questions include the following: What is the investor's tax situation? Are there any social, environmental, or governance considerations? Are legal, regulatory, and political issues a consideration? Does the IPS indicate any additional constraints?
5. *Select the asset allocation approach.* This is the asset allocation that is most ideal for the investor's situation (e.g., asset-only, liability-relative, goals-based).
6. *Specify the asset classes.* Once the asset classes are appropriately specified, capital market expectations can be established.
7. *Develop potential asset allocations.* With optimization procedures, a number of asset allocation choices can be constructed for investor consideration.
8. *Simulate results of potential asset allocations.* The potential asset allocations should be tested to see if the results align with the investor's objectives and risk tolerance for the chosen investment horizon.
9. *Repeat Step 7 until the optimal asset allocation is discovered.*

Once the strategic allocation has been implemented, it should be monitored regularly as specified in the IPS. The monitoring process should contain a feedback loop so that changes in long-term market factors can be incorporated back into the model. An assessment can then be made to determine whether adjustments to the strategic allocation are justified. If the market changes are only short term in nature, the manager should consider implementing tactical allocation measures, as will be discussed elsewhere.

MODULE QUIZ 18.3

To best evaluate your performance, enter your quiz answers online.

1. Which of the following investment objectives would *most likely* be associated with a defined benefit pension fund?
   A. Plan assets should meet current and future plan liabilities.
   B. Assets should provide for retirement subject to each investor's constraints and risk tolerance.
   C. The rate of return should meet the current distribution rate plus future inflation.
2. Which of the following statements identifies one criterion for specifying an asset class when making asset allocation decisions?
   A. Assets may be classified into more than one asset class.
   B. Asset classes cover all possible investable assets.
   C. Asset classes should be highly correlated in order to provide desired diversification.
3. Duration and convexity would *most likely* be risk factors for which type of asset class?
   A. Domestic equities.
   B. Domestic real estate.
   C. Domestic fixed income.

MODULE 18.4: EXAMPLE: STRATEGIC ASSET ALLOCATION

Video covering this content is available online.

PROFESSOR'S NOTE

The following example provides a general overview of constructing a strategic asset allocation.

EXAMPLE: Strategic asset allocation

Nathan Tillman is a 50-year-old entrepreneur who plans to retire in five years. He is considering purchasing an annuity for retirement. He has a $5 million portfolio with $1 million in real estate and $700,000 in mortgage debt. He would like to eliminate all mortgage debt before retirement. His son, David, is 18 years old and starting college this year with eventual plans for medical school. Tillman estimates he will contribute $500,000 to his son's education. Tillman is generally conservative with his investments, does not like portfolio volatility, and does not have any social or environmental investment constraints. For asset allocation A and then for asset allocation B:

- **State** whether it is most consistent with (1) an asset-only, (2) a liability-relative, or (3) a goals-based approach to asset allocation.
- **Give** one reason based on Tillman's situation that the approach is appropriate for Tillman.

Do not draw any conclusion as to the optimal overall approach to allocation for Tillman.

Asset Allocation	Cash	Global Equities	Global Fixed Income	Diversifying Strategies
A	45%	15%	40%	5%
B	10%	50%	20%	25%

Answer:

Asset allocation A is consistent with a goal-based approach because:

- It has more than sufficient cash for liquidity needs of $1.2 million to pay the mortgage and education expense. The cash can also be used for the possible annuity purchase.
- The high allocation to cash would reduce portfolio volatility.
- It fits his conservative investment views.

Asset allocation B is consistent with an asset-only approach because:

- It emphasizes higher growth equity.
- It provides diversification with alternative investments and some fixed income.

Note that you were directed not to draw any final conclusion. This was an initial step that illustrates the need to develop a complete IPS and consider additional asset allocations that may best meet those objectives.

MODULE 18.5: OTHER APPROACHES AND ISSUES

LOS 18.g: Describe the use of the global market portfolio as a baseline portfolio in asset allocation.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 200

Financial theory proposes that the first asset allocation to consider should be the **global market portfolio**. This portfolio contains all available risky assets (i.e., global equity, global fixed income, real estate, etc.) in proportion to their total market values. It is also the portfolio that minimizes diversifiable risk since it is the most diversified portfolio possible. The market portfolio is found on the efficient frontier by drawing a line from the risk-free asset that is tangent to the efficient frontier (known as the capital market line). The point of tangency is the location of the global market portfolio.

The asset class weights within the global market portfolio serve as a good starting point for asset allocation. The portfolio's weights can then be adjusted to meet specific investor objectives, constraints, and desires (e.g., a home-country or small-cap basis).

Note that it's challenging to invest in some asset classes within the global market portfolio. For example, investments in residential real estate or private equity may not be practical for individual investors. For this reason, investors often use a proxy to represent the global market portfolio, such as a portfolio of exchange-traded funds (ETFs).

PROFESSOR'S NOTE

In our edition of the CFA text, it says the global market portfolio minimizes *nondiversifiable* risk. That is a typographical error. You should know this from Level I and II material. You should know that in capital market theory, the global market portfolio eliminates diversifiable risk and leaves you with the nondiversifiable risk.

Also recall that nondiversifiable risk can be called market, priced, or systematic risk. Diversifiable risk can also be called non-market, non-priced, company-specific, or unsystematic risk. Finally, remember that you should expect compensation in the form of higher expected return for taking nondiversifiable risk but not for taking diversifiable risk.

STRATEGIC IMPLEMENTATION CHOICES

LOS 18.h: Discuss strategic implementation choices in asset allocation, including passive/active choices and vehicles for implementing passive and active mandates.

CFA® Program Curriculum, Volume 3, page 209

Once the strategic asset allocation has been constructed, implementation choices must be made regarding passive/active management for both asset class weights and allocations within asset classes. The first aspect of passive/active choices is to determine if the investor should deviate from the strategic asset allocation by adjusting the asset mix. The second aspect is to decide how investors should make allocations within selected asset classes. Managing and monitoring the portfolio in terms of a client's changing needs is an important element of portfolio management.

Passive/Active Choices for Asset Class Weights

Tactical asset allocation (TAA) is an active management strategy that deviates from the strategic asset allocation (SAA) to take advantage of perceived *short-term* opportunities in the market. TAA introduces additional risk, seeking incremental return, often called alpha. These deviations from the SAA weightings by asset class should be restricted by risk budgets or rebalancing ranges that control the amount of deviation. The deviations may be based on forecasted asset class valuation, business cycle state, or stock price momentum. A multiperiod view of the investment horizon is sometimes referred to as **dynamic asset allocation** (DAA). DAA recognizes that asset (and liability) performance in one period affects the required rate of return and acceptable level of risk for subsequent periods. Changes to the SAA may be limited to simply adjusting the mix between stocks, bonds, and cash. Conversely, global TAA may involve a broader and more complex multiasset approach.

With tactical asset allocation, there is a tradeoff between potential outperformance and tracking error. A key limitation of this approach is the additional trading and monitoring costs as well as possible capital gains taxes. Thus, the decision to implement a tactical asset allocation should be evaluated under a cost-benefit approach.

Passive and Active Choices Within Asset Classes

Passive and active management choices can also be made regarding the allocations within asset classes. Under **passive management**, investor insights or expectations do not impact the composition of the portfolio. Examples of a passive approach include indexing or holding bonds to maturity. With indexing, the portfolio may add or drop positions based on the index holdings, but it would not react to the changing expectations of investors regarding valuations. In contrast, under **active management**, the portfolio composition changes when investor insights or expectations change. The goal of active management is to earn risk-adjusted returns that exceed an associated passive benchmark.

To better understand the degree of passive/active management in a portfolio, we can
view decisions along a spectrum from most passive to most active. The most passive 1
approach would include buying and holding a self-rebalancing, broad index of risky
倾斜
assets, such as the global market portfolio. Tilting the allocation toward a certain
investment style index (e.g., growth equity index) is slightly more active given that it 2
involves an active decision, but it still uses the passive implementation of indexing. The
next step toward a more active approach would involve taking a growth investment
3 approach while using security selection to enhance returns. The most active approach 4
would include unconstrained mandates where the portfolio is not managed with regard
to traditional benchmarks.

In general, indexing is considered a low-cost means of investing. However, some transaction costs are involved when the portfolio must adjust positions based on the changing composition of the index. Furthermore, if the index is tracked with a different weighting approach, such as equally weighted rather than market-cap weighted, additional transaction costs will apply. Portfolios that follow a fixed-income index will also incur transaction costs as bonds reach maturity, are called, or default. As a portfolio moves from passive to active, tracking error and expected active return relative to a benchmark will increase. These measures quantify the degree of active management within a portfolio.

The decision of where to invest along the active/passive spectrum depends on the following factors:

- Availability of appropriate investments (e.g., a relevant index).
- Active management scalability in terms of value added from each active decision.
- Investor constraints, such as social and environmental concerns, when using a passive approach.
- An investor belief in efficient markets, which would discourage the use of active management.
- The cost-benefit tradeoff where additional transaction costs are needed for achieving excess returns.
- The tax status of investors, which differs between taxable and tax-exempt investors.

Risk Budgeting

Asset allocation can also be conducted with a risk perspective. The types of risk to take, as well as the amount of risk to take, is addressed with **risk budgeting**. Measuring risk may differ depending on the risk focus, such as volatility of returns or tail risk. In these cases, risk would be quantified with the standard deviation of returns and value at risk (VaR), respectively. Risk budgets can be established in either relative or absolute terms and stated in either money or percentage terms (e.g., 10% return volatility). These risk budgets specify how risk should be distributed among portfolio assets without regard to asset expected returns.

In the context of making passive/active asset allocation choices, active risk budgeting determines how much additional risk the investor is willing to take relative to the benchmark. The objective of this approach is to outperform the benchmark while sticking to the investor's risk budget. Regarding passive/active choices for the asset class mix, active risk is determined relative to the strategic asset allocation benchmark. Regarding passive/active choices for allocation within asset classes, active risk is determined relative to the asset class benchmark.

REBALANCING

LOS 18.i: Discuss strategic considerations in rebalancing asset allocations.

CFA® Program Curriculum, Volume 3, page 218

Strategic asset allocation responds to the interaction of the investor's long-term strategic (policy) needs and long-run capital market expectations. The investor's goals are expressed in terms of IPS objectives and constraints. The allocation itself is typically specified in a range of percentages (e.g., a strategic allocation for domestic equity of 30% to 40%), and if the actual percentage wanders outside that range, the portfolio needs to be rebalanced. Rebalancing can be triggered by normal asset price changes, which cause the asset mix to fluctuate from its target weights.

The primary benefit of rebalancing is maintaining the investor's desired exposure to systematic risk factors. If the portfolio is allowed to simply drift, the riskier assets in the portfolio tend to take over. For example, as the value of the equities in a portfolio increases, the equities become an ever larger percentage of the portfolio and the risk of the portfolio increases accordingly. Only by rebalancing the portfolio (e.g., selling equities and buying debt) will the portfolio return to its original risk and return characteristics as specified in the investor's IPS.

Rebalancing also provides discipline. Often the investor will see significant gains in the equity portion of the portfolio and want to "let it ride." Successful performance may lead the client to react to temporary market conditions rather than follow a long-term, disciplined approach. But "letting it ride" can also lead to the failure to realize the gains from temporarily overvalued securities before they fall back to their true values. This could be considered a potential cost of not rebalancing.

Of course, when equities become too large of a portion within the portfolio and we sell them to rebalance, there is an associated tax liability. In addition, the investor will face transaction costs. The costs of rebalancing can be affected by the conditions under which the trade is made (i.e., whether the trade requires liquidity from or provides liquidity to the market). If the manager is selling when other managers are selling, the trade requires liquidity and the associated transaction cost (bid-ask spread) can be substantial. If the trade provides liquidity, on the other hand (e.g., selling when others are buying), the costs may be minimal.

Rebalancing Approaches

Rebalancing an allocation to its precise target weight requires more or less constant trading. With constant analysis and trading come the associated transaction costs and the inability to time trades. Rather than set strict target allocations, managers will set allowable ranges that they consider optimal for the asset classes. In order to provide discipline to portfolio rebalancing, managers can adopt either calendar-based rebalancing or range-based balancing.

Calendar rebalancing. As its name implies, calendar rebalancing is rebalancing the portfolio to its strategic allocation on a predetermined, regular basis (e.g., monthly or quarterly). Generally, the frequency of rebalancing depends on the volatility of the portfolio, but sometimes rebalancing is scheduled to coincide with review dates.

The primary benefit to calendar rebalancing is that it provides discipline without the requirement for constant monitoring. The drawback is that the portfolio could stray 走失 considerably between rebalancing dates and return to its strategic allocation ranges on the rebalancing date. In other words, rebalancing is related to the passage of time rather than the value of the portfolio.

Percentage-range rebalancing. With this approach, rebalancing is triggered by changes in value rather than calendar dates. The manager sets what are called tolerance bands or corridors that are considered optimal for each asset class. For example, a corridor of 50% ± 5% would indicate that the related asset class must stay within a band of 45% to 55%. If the asset class wanders outside that corridor, which would no doubt mean other classes have violated their corridors also, the portfolio is rebalanced.

By not waiting for specified rebalancing dates, range-based rebalancing provides the benefit of minimizing the degree to which asset classes can violate their allocation corridors. Cost is increased by the time and expense of constantly monitoring the portfolio (as compared to only checking valuations on the specified calendar dates) and by potentially more frequent trading.

When applying range-based rebalancing, the following four questions need to be addressed:

- Who is ultimately responsible for rebalancing the portfolio?
- How frequently should the portfolio be monitored for rebalancing decisions?
- What is the size of the rebalancing corridors?
- Should rebalancing to target weights be fully or only partially corrected?

Strategic Considerations

The optimal width of the corridor for an asset class will depend on the following:

- **Transaction costs.** Obviously, the more expensive it is to trade, the less frequently you should trade. If an asset is particularly illiquid, for example, trading can be quite expensive. In that case, the corridor for the class should be wide. In general, the more illiquid the asset, the wider the corridor.
- **Risk tolerance.** More (less) risk-averse investors will have tighter (wider) rebalancing corridors.
- **Correlations.** The more highly correlated the assets (allocations) in a portfolio, the less frequently the portfolio will require balancing. If all assets tend to move together, their values will tend to stay within acceptable ranges. For example, if stocks and bonds both increase 20% in value (assuming only stocks and bonds in the portfolio), their weights in the portfolio will probably stay within acceptable limits. However, if stocks increase 20% while bonds decrease 20%, they will probably both violate their corridors.
- **Momentum.** If investors believe that current trends will continue, an argument can be made for using wider rebalancing corridors. Conversely, if investors anticipate mean reversion, tighter rebalancing corridors should be applied.
- **Liquidity.** Illiquid investments, such as private equity and real estate, are typically associated with larger trading costs. These liquidity costs encourage the use of wider rebalancing corridors.
- **Derivatives.** Rather than selling underlying assets, a derivatives overlay strategy can be used to synthetically rebalance a portfolio. This approach results in lower transaction costs, lower taxes, and can be executed quicker and easier compared to rebalancing with only the underlying stock and bonds. The tradeoff is that derivatives require additional risk management when used as a rebalancing tool.
- **Taxes.** When making rebalancing decisions, taxes must be considered since realized capital gains and losses will impact investor taxes. Therefore, taxable portfolios will typically have wider rebalancing corridors than tax-exempt portfolios. The corridors may also be asymmetric due to tax savings (i.e., loss harvesting). This suggests that the range may be less below a certain target weight than above (e.g., the tolerance band may go from 48% to 55% for a 50% target weight).

Asset class **volatility** also has an impact on optimal corridor width. In the simplest situations, higher volatility *most likely* calls for narrower corridors in order to control risk. But the impact of volatility can be more complex than that. **Higher volatility** (in the absence of high positive correlation between classes) will lead asset class weights to shift more quickly.

- This argues for narrower corridors to control risk exposure. (Consider this the most common conclusion.)
- But more frequent rebalancing increases transaction costs. This argues for wider corridors to control transaction costs, particularly when those costs are substantial.

Ultimately the choice of corridor width depends on a trade-off between risk control, transaction costs, and correlations between classes. In complex situations, a quantified cost-benefit analysis will be required.

MODULE QUIZ 18.4, 18.5

To best evaluate your performance, enter your quiz answers online.

1. Jack Manning, CFA, and Tess Brown, CFA, have just joined a financial planning firm. They will work as a team assessing and managing the portfolios of individual clients. Manning will specialize in forming long-term capital market expectations. Brown focuses on relative value models to assess shorter-term over- and undervaluation. Based on this information, we would define the focus of:
   A. both Manning and Brown as tactical asset allocation.
   B. both Manning and Brown as strategic asset allocation.
   C. Manning as strategic asset allocation and Brown as tactical asset allocation.
2. Which of the following statements is *most correct* regarding the global market portfolio as the baseline portfolio in asset allocation?
   A. The market portfolio contains most investable risky assets.
   B. The market portfolio minimizes total risk since it is the most diversified portfolio.
   C. Investors can use a proxy to represent the market portfolio, such as a portfolio of exchange-traded funds (ETFs).
3. Deviation from strategic asset allocation due to short-term capital market expectations is *most correctly* called:
   A. active management.
   B. tactical asset allocation (TAA).
   C. alpha management.
4. Which of the following asset allocation rebalancing techniques provides discipline without need for constant monitoring?
   A. Range-based balancing.
   B. Corridor-based rebalancing.
   C. Calendar-based rebalancing.

KEY CONCEPTS

LOS 18.a

An economic balance sheet contains an organization's financial assets and liabilities, as well as any nonfinancial assets and liabilities that are applicable to the asset allocation decision. These nonfinancial assets and liabilities are referred to as extended portfolio assets and liabilities because they are not included on traditional balance sheets. A practical application of an investment that includes human capital (an extended portfolio asset) is a life-cycle balanced fund. These funds consider the changing levels of human capital and financial capital for an individual investor over time.

LOS 18.b

There are three types of asset allocation approaches: (1) asset-only, (2) liability-relative, and (3) goals-based. Asset-only approaches make asset allocation decisions based on the investor's assets. Liability-relative approaches involve asset allocation decisions based on funding liabilities. Goals-based approaches are geared toward asset allocations for subportfolios, which help an individual achieve lifestyle and aspirational financial objectives.

LOS 18.c

Risk concepts associated with asset-only approaches focus on asset class risk as well as constructing effective asset class combinations. The relevant risk measure is the standard deviation of portfolio returns. Risk concepts associated with liability-relative approaches focus on not having enough assets to pay liabilities when they come due. The relevant risk measure is the standard deviation of the surplus. Risk concepts associated with goals-based approaches focus on the risk of not being able to achieve the stated financial goals.

LOS 18.d

Asset classes have been appropriately specified if:

- Assets in an asset class have similar attributes from both a descriptive and statistical perspective.
- Assets cannot be classified into more than one asset class.
- Asset classes are not highly correlated.
- Asset classes cover all possible investable assets.
- Asset classes contain a sufficiently large percentage of liquid assets.

LOS 18.e

Investors select asset classes based on their desired exposure to common risk factors. Examples of risk factors include volatility, liquidity, inflation, interest rates, duration, foreign exchange, and default risk. Risk factor exposures may overlap across multiple asset classes. Examining these overlapping risk factors can help investors identify the correlations among asset classes.

LOS 18.f

Strategic asset allocation is long term in nature; hence, the weights are called *targets* and the portfolio represented by the strategic asset allocation is called the *policy portfolio*.

Selecting and justifying a strategic asset allocation based on investor objectives and constraints is outlined in the following nine steps:

1. Determine investor objectives.
2. Determine investor tolerance for risk.
3. Determine investor time horizon(s).
4. Determine investor constraints.
5. Select the asset allocation approach.
6. Specify the asset classes.
7. Develop potential asset allocations.
8. Simulate results of potential asset allocations.
9. Repeat Step 7 until the optimal asset allocation is discovered.

LOS 18.g

Investors may consider the global market portfolio as a baseline asset allocation. It will minimize (eliminate) diversifiable risk. Because it's challenging to invest in some asset classes within the market portfolio, investors often use a proxy, such as a portfolio of exchange-traded funds (ETFs).

LOS 18.h

The SAA can be implemented with passive or active management for both asset class weights and allocations within asset classes.

- TAA introduces active decisions to deviate from the SAA in an effort to add value, but it is likely to increase error.
- Active management security selection is based on investor insights or expectations.

Risk budgeting specifies which risks and how much of each risk can be taken. Active risk budgeting specifies risk as allowable deviations from the portfolio's benchmark.

LOS 18.i

Calendar rebalancing is done on a periodic basis, and percentage-range rebalancing is done when a corridor is breached.

Wider optimal corridors are associated with:

- Higher transaction costs (including costs due to tax and illiquidity).
- Increased investor risk tolerance.

- Higher correlations among asset classes.
- Belief in momentum and that trends persist.
- Less volatile asset classes.

Derivatives may allow synthetic rebalancing at a lower cost.

Capital gains taxation suggests setting asymmetric rebalancing corridors (e.g., a 28% to 35% range around a 30% target weight).

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 18.1, 18.2

1. **A** An economic balance sheet contains all of an organization's financial assets and liabilities, as well as any nonfinancial assets and liabilities that are applicable to the asset allocation decision. Extended portfolio assets may include the present value of expected earnings (i.e., human capital). The others are already part of a more traditional balance sheet. They are part of the economic balance sheet but not the extended section. (Module 18.1, LOS 18.a)
2. **B** Goals-based approaches are geared toward asset allocations for subportfolios, which help individuals or families achieve lifestyle and aspirational financial objectives. (Module 18.2, LOS 18.b)
3. **C** Risk concepts associated with liability-relative asset allocation approaches focus on not having enough assets to pay liabilities when they come due. (Module 18.2, LOS 18.b)

Module Quiz 18.3

1. **A** The objective for a defined benefit pension fund is for plan assets to meet current and ongoing plan liabilities. Choice B is generally appropriate but phrased more for an individual investor, and Choice C is appropriate for a foundation or endowment fund (and sometimes for individuals). Defined benefit plan inflation issues are already reflected in the actuary provided PVL. (LOS 18.c, 18.d, 18.e)
2. **B** As a group, asset classes cover all possible investable assets. Assets cannot be classified into more than one asset class. Also, asset classes should not be highly correlated. (LOS 18.d)
3. **C** The asset class of domestic fixed income would most likely include default risk, duration, and convexity risk factors in addition to foreign exchange, liquidity, and volatility risk factors. (LOS 18.e)

Module Quiz 18.4, 18.5

1. **C** Manning is using longer-term capital market expectations to form strategic asset allocation, while Brown is looking at shorter-term indicators, which is TAA. (Module 18.5, LOS 18.h)
2. **C** The global market portfolio contains *all* available risky assets in proportion to their total market values. It is also the portfolio that minimizes *diversifiable* risk since it is the most diversified portfolio possible. The total risk (standard deviation) of the market portfolio is not the lowest possible. Over any specific time period the risk-free asset has zero standard deviation. It's challenging to invest in some asset classes within the global market portfolio. For this reason,

investors often use a proxy to represent the global market portfolio, such as a portfolio of ETFs. (Module 18.5, LOS 18.g)

3. **B** Short-term deviations from the strategic asset allocation to take advantage of short-term capital market expectations is called TAA. The motives for TAA may well include active management and adding alpha, but they are less accurate labels for what was described. (Module 18.5, LOS 18.h)
4. **C** The primary benefit to calendar rebalancing is that it provides discipline without the requirement for constant monitoring. Range- or corridor-based rebalancing provides the benefit of minimizing the degree to which asset classes can violate their allocation corridors, but it can be more costly in that it requires continual monitoring of the portfolio. (Module 18.5, LOS 18.i)

The following is a review of the Asset Allocation and Related Decisions in Portfolio Management (1) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #19.

READING 19: PRINCIPLES OF ASSET ALLOCATION

Study Session 9

EXAM FOCUS

The reading reviews the mean-variance optimization (MVO) approach to strategic asset allocation (SAA) that has been taught at Levels I and II. The focus then shifts to MVO pitfalls and how MVO can be more practically applied to real-world portfolios.

The mathematics behind many of these discussions is beyond the scope of the exam or a typical charterholder. Do not try to learn details that are not covered in the material. If you want to pursue some of these for personal interest after the exam, a Google search is a good starting point.

MODULE 19.1: BASIC MEAN-VARIANCE OPTIMIZATION

LOS 19.a: Describe and critique the use of mean–variance optimization in asset allocation.

Video covering this content is available online.

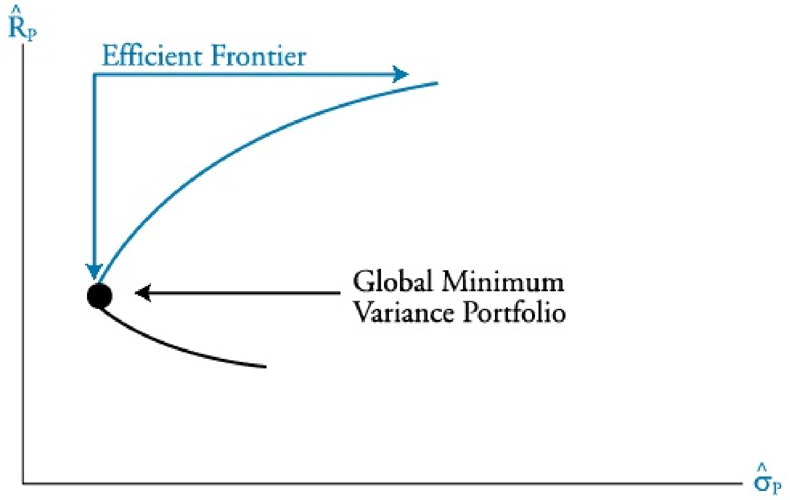
CFA® Program Curriculum, Volume 3, page 231

Creating a diversified portfolio with allocations to multiple asset classes requires:

- Asset allocation decision: using the investors' objectives and constraints to identify the appropriate portfolio weights for the various asset classes.
- Implementation decisions: identifying the specific assets within each asset class according to the weights specified in the first step.

Mean-variance optimization (MVO) is the most common approach to asset allocation. It assumes investors are risk averse, so they prefer more return for the same level of risk. Given an opportunity set of investable assets, their expected returns and variances, as well as the pairwise correlations between them, MVO identifies the portfolio allocations that maximize return for every level of risk. If the MVO analysis includes all investable risky assets, the result is the familiar "efficient frontier" (at least it should be familiar to the Level III candidate!), as shown in Figure 19.1. The analysis can also be constrained by an investor's objectives and constraints to some subset of assets suitable to that investor.

Figure 19.1: Mean-Variance Efficient Frontier



One approach to finding the optimal point on the efficient frontier for a given investor is to maximize that investor's utility:

Utility maximization: $U_m = E(R_m) - 0.005 \times \lambda \times Var_m$

U_m = the investor's utility from investing in a portfolio with asset allocation m

$E(R_m)$ = the expected return of the portfolio with asset allocation m (expressed as a %)

λ = the investor's risk aversion coefficient ("lambda")

$Var_m = \sigma^2_m$ = the variance of the portfolio with asset allocation m (expressed as a %)

PROFESSOR'S NOTE

The investor's utility function as shown assumes the expected return and variance are expressed in percentage terms (e.g., 8% is input as 8.00) so that the appropriate coefficient is 0.005. If the expected return and variance are expressed in decimal terms (e.g., 0.08), you should use the coefficient 0.5.

Lambda captures each individual investor's preference for trading off risk and return. If you look closely at the formula, you'll see that higher expected return for the same level of risk will increase the investor's utility, while a higher risk for the same level of return will decrease the investor's utility. This is consistent with a risk-averse investor, as it imposes a "penalty" for risk. U_m is also referred to as the *certainty-equivalent return*.

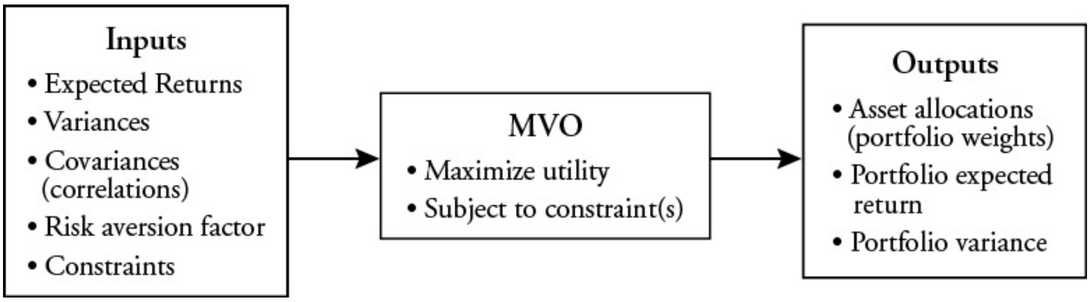
Lambda is unique to each individual and is based on the investor's willingness and capacity to take on risk. A risk-neutral investor will have a lambda of 0, although in practice it is typically assumed to be between 1 and 10 with an average level of 4.

Maximization problems in general usually also have constraints. In other words, the objective function is maximized subject to one or more constraints. These are restrictions on the variables in the objective function. In MVO, the constraints typically involve the portfolio weights, but they can also reflect restrictions on portfolio expected return, variance, or both.

The most common constraint in MVO is called the *budget constraint* or the *utility constraint*, which means the asset weights must add up to 100%. The next most common constraint used in MVO is the *nonnegativity constraint*, which means all weights in the portfolio are positive and between 0% and 100% (there are no short positions in the SAA). We will discuss other common constraints throughout this topic review.

A graphical depiction of MVO is shown in Figure 19.2.

Figure 19.2: MVO Process



Levels I and II focused on a more academic treatment of MVO. That approach assumed:

- All tradable assets were included in the optimization and efficient frontier.
    - We will no longer assume all assets are used or that the efficient frontier constructed from all assets is necessarily optimal for a given investor.
- That a true risk-free asset exists and the optimal allocation line between the risk-free asset and the efficient frontier identifies an optimal (the market) portfolio that all investor's should use (allocating between the tangent portfolio and risk-free asset). That optimal tangent portfolio is the portfolio on the efficient frontier with the highest Sharpe ratio.
    - We will no longer assume a true risk-free asset exists where risk-free means the variance of return is zero and return is uncorrelated with the return of other assets (correlation = 0).

Criticisms of MVO

There are a number of criticisms of MVO that we will address throughout this reading.

1. **GIGO**: The quality of the output from the MVO (portfolio allocations) is highly sensitive to the quality of the inputs (i.e., expected returns, variances, and correlations). In other settings, this is often called the "garbage-in-garbage-out" (GIGO) problem. Although all three inputs are a source of estimation error in MVO, expected returns are particularly problematic, so we focus here on addressing the quality of the expected return inputs.
2. **Concentrated asset class allocations**: MVO often identifies efficient portfolios that are highly concentrated in a subset of asset classes, with zero allocation to others; in other words, lowest calculated standard deviation is not the same thing as practical diversification.
3. **Skewness and kurtosis**: MVO analysis, by definition, only looks at the first two moments of the return distribution: expected return and variance; it does not take

into account skewness or kurtosis. But empirical evidence suggests quite strongly that asset returns are not normally distributed: there is significant skewness and kurtosis in actual returns.

4. **Risk diversification**: MVO identifies an asset allocation diversified across asset classes but not necessarily the sources of risk. For example, equities and fixed-income securities are two different asset classes, but they are driven by some common risk factors, and diversifying across the two classes won't necessarily diversify those risk factors.
5. **Ignores liabilities**: MVO also does not account for the fact that investors create portfolios as a source of cash to pay for something in the future: individual investors are looking to fund their consumption spending in retirement, for example, while pension funds are focused on funding the pension liability and repaying employees the retirement benefits promised to them. A more robust approach needs to account for the factors that affect these liabilities and the correlations between changes in value of the liabilities and returns on the asset portfolio.
6. **Single-period framework**: MVO is a single-period framework that does not take into account interim cash flows or the serial correlation of asset returns from one time period to the next. This means it ignores the potential costs and benefits of rebalancing a portfolio as capital market conditions change and asset allocations drift away from their optimal starting point.

We address critiques 1 through 4 in this LOS; critique 5 in LOS 19.j, 19.k, and 19.l; and critique 6 in LOS 19.g and 19.o.

The first two criticisms of MVO—GIGO and concentrated asset class allocations—can be addressed by:

- Improving the quality of the inputs, particularly expected return.
- Adding more constraints beyond the budget constraint and the nonnegativity constraint.
- Resampling MVO.

MODULE 19.2: REVERSE OPTIMIZATION, BLACK LITTERMAN, RESAMPLING, AND OTHER APPROACHES

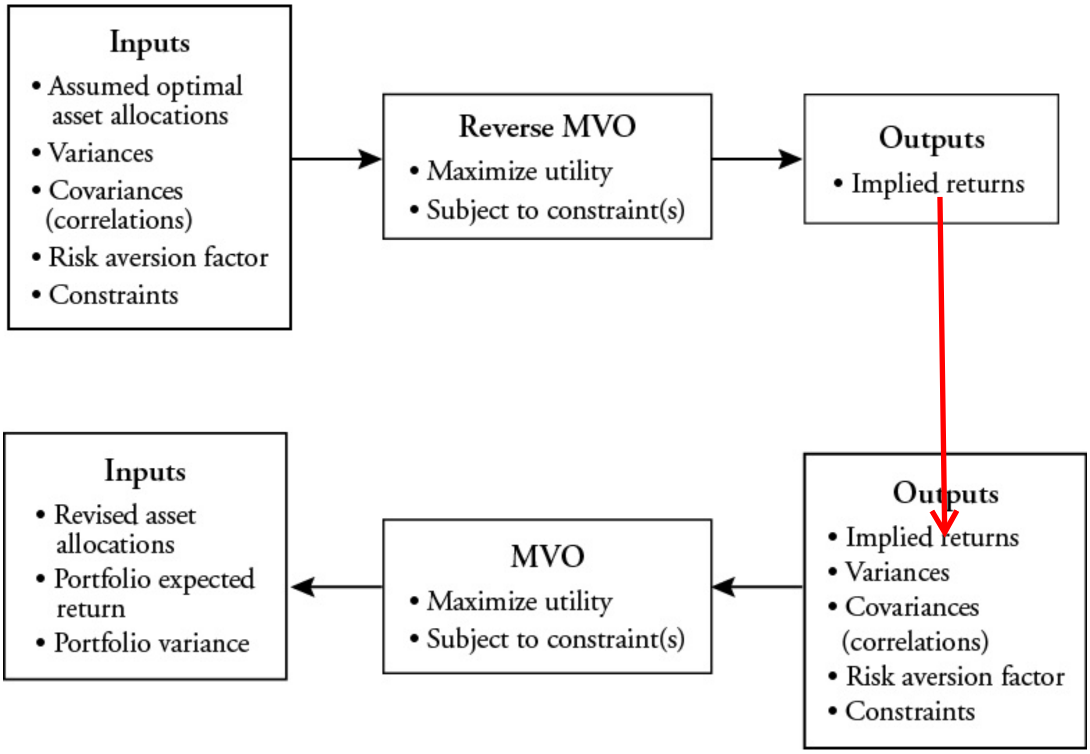
Improving the Quality of the Inputs

Video covering this content is available online.

Reverse optimization (Black-Litterman is an extension of this) can be used to improve the return estimates.

Reverse optimization is just what it sounds like: instead of starting with expected returns (and the other inputs) and deriving optimal portfolio weights, start with what we assume to be "optimal" portfolio weights from the global market portfolio and derive the expected returns consistent with those weights. Then we use these return estimates (called implied returns) to do a traditional MVO and derive optimal portfolio weights for our particular investor. This process is depicted in Figure 19.3.

Figure 19.3: Reverse Optimization

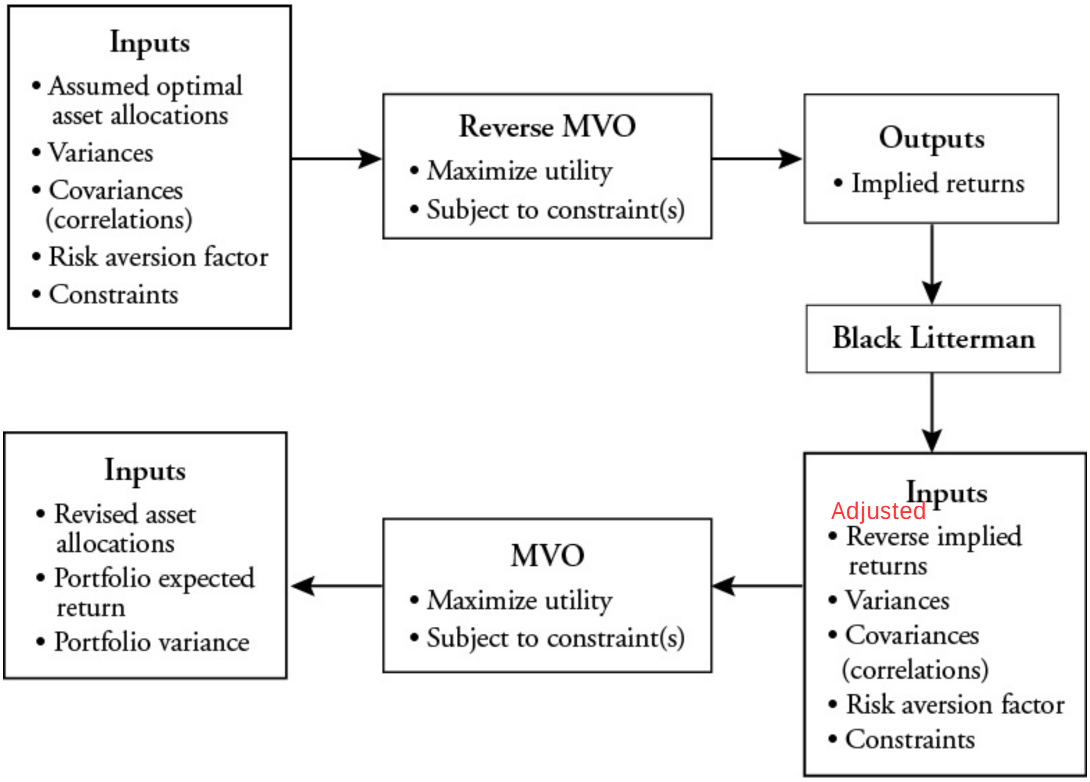


It is common to assume the world market portfolio provides optimal diversification and is therefore the appropriate starting point for weights to use in reverse optimization. The advantage of this is the derived returns already reflect a highly diversified portfolio and you avoid the tendency of MVO to come up with highly concentrated (in a few asset classes) allocations. Other starting points are possible, such as the weights from an existing IPS of the client.

The **Black-Litterman model** is an extension of reverse optimization in which the implied returns (actually implied excess returns) from a reverse optimization are subsequently adjusted to reflect the investor's unique views of future returns. For example, if reverse optimization:

- Derives an expected return for emerging market equities of 6.5% and you believe this is too low, you could adjust the expected return by 75 basis points to 7.25%. You can then rerun the MVO using your adjusted return estimates.
- Projects a return for U.K. large-cap equities of 8.2% and U.S. large-cap equities of 8.0% (a return differential of 20 basis points) and you believe that U.S. large-cap equities will outperform U.K. large-cap equities by 100 basis points, adjust the differential. Figure 19.4 displays a schematic view of the Black-Litterman model.

Figure 19.4: Black-Litterman Model



Adding More Constraints

Adding constraints beyond the budget and nonnegativity constraint can be used to address the GIGO and highly concentrated allocation issues. These constraints are usually intended to make the asset allocation more acceptable to an investor's desires to include or exclude (in total or in part) certain asset classes. Typical examples of additional constraints include:

- Specifying a fixed allocation to one or more assets, often human capital or other nontradable assets. (This will be discussed in more detail shortly.)
- Setting an asset allocation range for an asset class (e.g., 10% to 15% for global REITs).
- Setting an upper limit on the asset allocation to an asset class to address liquidity issues (e.g., no more than 10% to private equity).
- Specifying a relative allocation between two or more classes (e.g., the allocation to Asia bonds must be less than Asia equities).
- In a liability-relative setting, including a constraint to require an allocation to assets that hedge the liability. (This will also be discussed in more detail shortly.)

However, if too many such constraints exist, you're not really optimizing anymore; you're trying to force the asset allocation outcome you want.

Resampled MVO

Resampling can also be used to address the GIGO and highly concentrated issues:

- Resampling starts with the basic MVO using the best estimates of expected returns, sigma, and correlations to generate the efficient frontier and associated asset allocations for each point on the frontier.

- Then Monte Carlo simulation is used to generate thousands of random variations for the inputs around the initial estimates, resulting in efficient frontier and associated asset allocations for each point on the frontier.
- The resampled efficient frontier is an average of all the simulated efficient frontiers, and the asset allocation for any single point on the resampled efficient frontier is an average of the possible portfolios for that point on the frontier.

PROFESSOR'S NOTE

Use some professional common sense. This is too much math for you to be asked to do on the exam, but the concept is simple (e.g., here are my best guesses of inputs, here are lots of variations around those best guesses, and here is the average of the asset allocations to get me to a 5% expected portfolio return). An average has to be more stable than the allocation from any one set of guesses. Furthermore, every asset class that appears in a single possible allocation will be included in the average asset allocation, so the average allocation will likely include more asset classes than found in a single allocation.

Non-Normal Distributions (Skewness and Kurtosis)

The third critique of MVO, that it ignores skewness and kurtosis in asset returns, can be addressed by various extensions of MVO. You could directly incorporate skewness, kurtosis, or both into the utility function and use an asymmetric definition of risk, such as conditional value-at-risk (VAR), instead of variance.

PROFESSOR'S NOTE

The details of these models are beyond the scope of the Level III curriculum.

MODULE 19.3: EXAMPLE

LOS 19.b: Recommend and justify an asset allocation using mean–variance optimization.

LOS 19.i: Recommend and justify an asset allocation based on the global market portfolio.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, pages 231 and 301

EXAMPLE: Recommending and justifying an asset allocation using MVO

Marsha Bronsten has come to her investment adviser for help to determine an appropriate asset allocation. The adviser discerns in conversations with Bronsten that her risk tolerance is average ($\lambda = 4$) and that she would also like to minimize the chance of earning less than 3%. The available asset allocations are as follows:

	Expected Return	Variance
Allocation 1	8%	0.0225
Allocation 2	6%	0.0144

Allocation 3	4%	0.0025

Recommend which of the three strategic asset allocations is appropriate for Bronsten.

Answer:

The first step is to calculate the certainty-equivalent return for each allocation using the equation $\boxed{U_m = E(R_m) - 0.5 \times \lambda \times Var_m.}$

$U_1 = 0.08 - 0.5 \times 4 \times 0.0225 = 0.0350 = 3.50\%$

$U_2 = 0.06 - 0.5 \times 4 \times 0.0144 = 0.0312 = 3.12\%$

$U_3 = 0.04 - 0.5 \times 4 \times 0.0025 = 0.0350 = 3.50\%$

Based solely on the criteria of the certainty-equivalent return, Bronsten is indifferent between allocations 1 and 3, but prefers them both to allocation 2.

The second step is to calculate Roy's safety-first criterion, which is equal $\boxed{\text{to } \frac{R_P - R_L}{\sigma_P}}$ and identifies the portfolio with the highest probability of exceeding the threshold return of R_L = 3%.

$$\text{Allocation1}: \frac{0.08 - 0.03}{\sqrt{0.0225}} = 0.33$$

$$\text{Allocation2}: \frac{0.06 - 0.03}{\sqrt{0.0144}} = 0.25$$

$$\text{Allocation3}: \frac{0.04 - 0.03}{\sqrt{0.0025}} = 0.2$$

Allocation 1 has a higher probability of exceeding the threshold return than allocation 3, so the adviser should recommend allocation 1 to Bronsten.

Note that the data was given in a mixture of percent and decimal forms. The solution converted all data to decimal form. You could have also converted everything to percent form. For example:

$U_1 = 8.00 - 0.005 \times 4 \times 225 = 3.50\%$

$$\text{Allocation1}: \frac{8 - 3}{\sqrt{225}} = 0.33$$

The ranking and conclusions will be the same. The approach you take is just personal preference.

EXAMPLE: Recommending and justifying an asset allocation using MVO

The Plowshare University endowment fund has an annual return objective of 9%, which is sufficient to cover its spending rate, expected inflation, and cost of earning investment returns. Its risk objective is to minimize risk (as measured by standard deviation of returns) while meeting its minimum expected return objective. The table provides the output from an MVO with a budget constraint and a nonnegativity constraint.

	Expected Return	Standard Deviation of Returns
Allocation AA	15%	24%
Allocation BB	18%	27%

Allocation CC	12%	20%
Allocation DD	10%	14%

The risk-free rate is 3%. If the client and manager believe a true risk-free asset exists and can be used to construct the SAA, **identify** the appropriate asset allocation for Plowshare and **calculate** the risk of the optimal allocation.

Answer:

The first step is to calculate the Sharpe ratio for each allocation.

$$\text{Sharpe ratio AA} = \frac{15\% - 3\%}{24\%} = 0.5$$

$$\text{Sharpe ratio BB} = \frac{18\% - 3\%}{27\%} = 0.56$$

$$\text{Sharpe ratio CC} = \frac{12\% - 3\%}{20\%} = 0.45$$

$$\text{Sharpe ratio DD} = \frac{10\% - 3\%}{14\%} = 0.5$$

The optimal risk allocation is BB as it has the highest Sharpe ratio.

The second step is to calculate the mix between BB and the risk-free asset assuming the return objective is 9%. Allowing w_{BB} to be w is calculated as follows:

$9\% = 18\%(w) + 3\%(1 - w)$

$9 = 18w + 3 - 3w$

$6 = 15w$; therefore, $w_{BB} = 0.40$

The optimal portfolio invests 40% in allocation BB and 60% in the risk-free asset.

The risk (standard deviation) of the optimal portfolio is as follows:

$\sigma_{BB} \times w_{BB} = 27\% \times 0.40 = 10.8\%$

MODULE QUIZ 19.1, 19.2, 19.3

To best evaluate your performance, enter your quiz answers online.

1. Which of the following methods is *most appropriate* for addressing highly concentrated allocations in portfolios?
   A. Reverse optimization.
   B. Monte Carlo simulation (MCS).
   C. Liability-relative MVO.
2. Jane Cullis is considering three potential asset allocations. She wishes to earn a nominal return of no less than 4%, and she has a high risk tolerance with a lambda of 2.

   The following asset allocations are available:

	Expected return	Variance
Allocation 1	6%	0.02

u1=0.04-0.5*2*0.02=3%

	Expected return	Variance	
Allocation 2	8%	0.03	u2=0.08-0.5*2*0.03=5%
Allocation 3	10%	0.04	u3=0.1-0.5*2*0.04=6%

Based on the information provided, which of the following allocations should Cullis choose?

A. Allocation 1.
B. Allocation 2.
C. Allocation 3.

3. Melody Chan is considering three potential asset allocations. She wishes to earn a nominal return of no less than 4% and maximize her chances of exceeding a 4% return.

The following asset allocations are available:

	Expected return	Variance	
Allocation 1	6%	0.02	Roy's first =(R-Rl)/Sigma=1 (6%-4%)/sqrt(0.02)
Allocation 2	8%	0.09	4/9
Allocation 3	10%	0.16	6/16=3/8

Based on the information provided, which of the following allocations would Chan *most likely* choose?

A. Allocation 1.
B. Allocation 2.
C. Allocation 3.

MODULE 19.4: ISSUES FOR INDIVIDUALS

LOS 19.c: Interpret and critique an asset allocation in relation to an investor's economic balance sheet.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 247

So far, we have only considered tradable financial assets such as equities and bonds. However, a significant portion of the typical investor's asset portfolio is human capital, as well as the residential real estate property the investor owns and lives in. We can adapt the MVO framework to incorporate these kinds of assets into the analysis.

For investors who have stable jobs with consistent wages that increase with inflation, we can model the cash flows associated with human capital (future wages) as an inflation-linked bond. For individuals with less certain and more volatile future wages, we could model their human capital as a mix of inflation-linked bonds, equities, and corporate bonds. By including this source of economic value in the investor's portfolio, the individual's capacity to take on additional risk is increased. Because human capital is not tradable, one of the constraints must be to set the percentage allocation to human capital at whatever it is currently valued at in relation to the investor's total portfolio value.

Residential real estate owned by the investor can be treated in a similar fashion, with return and risk inputs estimated using a residential real estate property index for the investor's geographic region. Once again, the allocation to the property must be constrained to its current value as a percentage of the investor's total portfolio.

Because human capital and residential real estate property are two large but often overlooked components of an investor's total investment portfolio, including them in the analysis along with traditional investment vehicles increases the investor's capacity to bear risk.

LOS 19.g: Discuss the use of Monte Carlo simulation and scenario analysis to evaluate the robustness of an asset allocation.

CFA® Program Curriculum, Volume 3, page 243

MCS can be used to:

- Address the limitations of MVO as a single-period model and the related issues of rebalancing and taxes in a multiperiod framework. In a single-period model, taxes are easy to incorporate into the analysis, and rebalancing the portfolio is irrelevant. However, in a multiperiod framework, rebalancing to move toward a strategic allocation target will involve buying and selling investments that trigger taxable capital gains and losses. Also, investors will save (add) money into and spend money out of their portfolio, resulting in interim cash flows. It is relatively straight-forward to do this at each future point in an MCS.
- Guide individual investors to identify their risk tolerance level. MCS can be useful in illustrating the range and likelihood of possible outcomes given various assumptions. Clients planning for retirement can visually see how often and when they are likely to run out of money.

PROFESSOR'S NOTE

Monte Carlo simulation (MCS) has multiple uses. It is essentially a random number generator, but random means random within user-defined boundaries. We saw MCS used in resampling to generate a range of possible inputs for MVO where the range was around the best guess of inputs. Here, MCS is being used another way—to simulate multiple future return paths for a portfolio over time. The various paths are based around a best guess of expected return and risk for the portfolio.

LOS 19.d: Discuss asset class liquidity considerations in asset allocation.

CFA® Program Curriculum, Volume 3, page 259

Less-liquid asset classes like direct real estate, infrastructure, and private equity require a liquidity return premium to compensate the investor for the additional liquidity risk. However, these asset classes are difficult to include in MVO because:

- There are few indexes available that accurately track these illiquid investments, making it harder to find data to use for estimating return, risk, and correlations.

- Even where indexes exist to provide return data, they are generally not investable as a passive alternative to active management of these asset classes.
- The risk-return characteristics of a specific real estate, private equity, or infrastructure investment are different from those of its asset class. For example, investing in the infrastructure asset class (assuming it is possible) should reflect the characteristics of a portfolio of all infrastructure, with only systematic risk priced. However, any one infrastructure fund is not fully diversified and, therefore, its risk and return characteristics reflect both systematic and nonsystematic risk.

To address these issues:

- Exclude illiquid asset classes when running an MVO, but use them to meet separately set target asset allocations.
- Include the illiquid asset classes in MVO and model the inputs of the specific (not asset class) investments you plan to use (i.e., the risk estimate will be based on both nonsystematic and systematic).
- Include the illiquid asset classes in MVO using highly diversified asset class inputs, recognizing that the actual investments made may have different characteristics. The input estimates for this approach are normally made using reported alternative investment indexes. Such indexes are usually not pure representations of the asset class but include characteristics of other asset classes as well. This violates the requirement that asset classes be mutually exclusive and biases the reported correlations upward.

MODULE QUIZ 19.4

To best evaluate your performance, enter your quiz answers online.

1. Louise Davey is 26 years old and has just paid off her student loans from college and hopes to begin saving to accumulate a portfolio. She is currently set to begin a career as a licensed insurance salesperson, working primarily on a commission-based pay structure. Louise is an only child and will be the sole beneficiary of her parents' substantial estate, which she estimates she will receive in about 30 years.

   Based on the information provided, which of the following statements is *most accurate*?

   A. Louise's human capital could likely be modeled as an inflation-linked bond.
   B. Louise's capacity to bear investment risk is relatively high.
   C. Louise's human capital is a small component of her total economic worth.
2. When dealing with illiquid assets, such as the investor's personal residence or a private company he owns, it is *most accurate* to say:
   A. a liquidity premium reduces the assets' expected return.
   B. the positions can be excluded when running mean variance optimization for the client.
   C. use data on publicly available funds to model the specific characteristics of the client's holdings when running mean variance optimization for the client.
3. Which of the following methods is the *least appropriate* way of incorporating client risk preferences into asset allocations?
   A. Specify additional constraints.

B. Specify a maximum return.
C. Use MCS.

4. Which of the following statements regarding MCS is *most accurate*?
   A. MCS replaces mean variance optimization (MVO) by addressing the limitations of MVO.
   B. There is a high level of consistency between the MCS tools available in the marketplace.
   C. MCS is not necessary to model taxes and portfolio rebalancing in a single period.

MODULE 19.5: A RISK BUDGETING APPROACH

LOS 19.e: Explain absolute and relative risk budgets and their use in determining and implementing an asset allocation.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 261

The goal of risk budgeting is to maximize return per unit of risk, where we can define risk as total portfolio risk, active risk, or residual risk.

The marginal contribution to portfolio risk is the change in total portfolio risk for a small change in the asset allocation to a specific asset class. For those of you with calculus backgrounds, it's the partial derivative of risk with respect to changes in portfolio allocations. Absolute contribution to total risk (ACTR) is the asset classes' contribution to portfolio volatility.

By estimating each asset classes' marginal contribution to total risk (MCTR), we can (1) see what happens to portfolio risk as we change individual allocations, (2) identify optimal allocations, and (3) develop a risk budget.

Here are some useful formulas:

Marginal contribution to total risk: $MCTR_i$ = (beta of asset $class_i$ with respect to the portfolio)(total portfolio risk as measured by standard deviation)

Absolute contribution to total risk: $ACTR_i = (weight_i)(MCTR_i)$

% of risk contributed by $position_i = ACTR_i$ / total portfolio risk

The optimal allocations to each asset class occur when the ratio of excess return to MCTR is equal for all asset classes and is equal to the portfolio Sharpe ratio.

A simple example of a portfolio with an optimal risk allocation is shown in Figure 19.5.

Figure 19.5: Optimal Risk Allocation Example

	Weight	Excess Return	Beta	MCTR	ACTR	% Contribution to Risk	Ratio of Excess Return to MCTR
U.S. equities	60%	6.50%	1.300	15.60%	9.36%	78.03%	0.417
U.S. bonds	30%	3.66%	0.732	8.78%	2.64%	21.97%	0.417
Cash	10%	0.00%	0.000	0.00%	0.00%	0.00%	

Total portfolio	100%	5.00%	1.000	12.00%	100.00%

Note that the portfolio excess return is 5% (the weighted average of the excess returns of each asset class) and the portfolio standard deviation is 12%. Here are the calculations for U.S. equities:

$MCTR_{equities}$ = 1.300 × 12.00% = 15.60%

$ACTR_{equities}$ = 0.60 × 15.60% = 9.36%

% contribution to total $risk_{equities}$ = 9.36% / 12.00% = 78.00%

ratio of excess return to $MCTR_{equities}$ = 6.5% / 15.60% = 0.417

Note also that the portfolio Sharpe ratio of 5% / 12% = 0.417 is equal to the ratio of excess return to MCTR for both U.S. equities and U.S. bonds. Therefore, the 60/30/10 allocation is optimal from a risk-budgeting perspective.

LOS 19.f: Describe how client needs and preferences regarding investment risks can be incorporated into asset allocation.

CFA® Program Curriculum, Volume 3, page 255

We have discussed a number to ways to incorporate client risk preferences into the asset allocation:

- Specify additional constraints, such as setting limits on allocations to risky asset classes or setting a ceiling on portfolio risk. We did this in the Plowshare example.
- Specify a risk aversion factor for the investor, as we did in the first example with Marsha Bronsten when we assumed she was an average investor and her risk aversion factor was 4.
- Use MCS to illustrate to the investor the various wealth outcomes possible from assuming allocations with different levels of risk.

LOS 19.h: Describe the use of investment factors in constructing and analyzing an asset allocation.

CFA® Program Curriculum, Volume 3, page 263

Up to this point, our opportunity set of investments consisted of asset classes, such as equities, fixed income, REITs, etc. Another approach is to define the opportunity set as factors, such as market exposure, size, valuation, momentum, liquidity, duration, credit, and volatility.

This approach is consistent with fundamental factor return models, such as the Fama-French model, in which the factors are the market portfolio, size, and value-growth.

The factors themselves are zero-dollar investment portfolios that are long the better performing attribute and short the underperforming attribute. For example, there are three factors in the Fama-French model:

- A zero-dollar portfolio long in small stocks and short in large stocks (the size factor).

- A zero-dollar portfolio long in value (high book-to-market) stocks and short growth (low book-to-market) stocks (the value-growth factor).
- The market portfolio.

Because of the way the factors are formed, they are not highly correlated with each other or the market portfolio, which improves the risk-return tradeoff from the optimal portfolios and expands the efficient frontier.

Once the factor portfolios, their expected returns, variances, and covariances are identified, MVO can be used in the same manner as we've previously discussed to identify portfolios with optimal allocations to the factors.

Research comparing the results of MVOs using asset class exposures versus factor exposures indicates that when the two opportunity sets broadly reflect the same exposures (underlying assets), the resulting efficient frontiers are not significantly different (i.e., one approach is not clearly superior). The choice of approach depends on how you form capital market expectations (i.e., the space in which you operate). If you collect data and think in terms of asset class, allocate risk by asset class. If you collect data and think in terms of risk factors, allocate risk by risk factor.

MODULE QUIZ 19.5

To best evaluate your performance, enter your quiz answers online.

1. The following portfolio is being analyzed. The data is incomplete and does not show other asset classes held in the portfolio.

	Weight	Excess Return	Beta
Canadian equities	50%	8.25%	1.19
Canadian bonds	15%	2.75%	0.88

ExcessReturn/MCTR
=ER/(Beta*Sigmap)
=0.0825/1.19*10%
=0.693

The portfolio standard deviation is 10%.

Which of the following amounts is *closest* to the ratio of excess returns to marginal contribution to total risk (MCTR) for the Canadian equities within the portfolio?

   A. 0.313.
   B. 0.595.
   C. 0.693.

2. Regarding the use of investment factors in forming an asset allocation, it is *most accurate* to say:

   A. this method is superior to asset class–based allocations for institutional portfolios.
   B. this method will replicate the allocations produced by asset class–based allocations for institutional portfolios.
   C. factor exposures may be investable by forming a series of zero-dollar long/short portfolios.

MODULE 19.6: AN ALM APPROACH

Liability-Relative Asset Allocation

Video covering this content is available online.

In this section, we address critique 5 of MVO, that MVO as discussed so far does not address the relationship between the asset investment portfolio and the liabilities that the investor will repay using the cash flow from the asset portfolio. We will focus our attention here on institutional investors such as pension funds, insurance companies, and banks. All three have liabilities they are obligated to meet at some point in the future, and they face strict regulatory rules and penalties for failure to meet those obligations.

Let's use the example of a defined benefit (DB) pension plan to illustrate the key issues and provide some definitions. There are two components to a DB pension plan: the pension liability and the investment portfolio that is managed to meet the cash flow requirements of the liability. A pension plan promises workers a stream of payments upon retirement that is usually dependent on how long the employee has worked for the company, as well as the worker's salary in the last few years before retirement. The pension liability represents the present value (calculated at the appropriate discount rate) of those future retirement obligations of the plan.

The plan surplus and the funding ratio are calculated as follows:

plan surplus = market value of investment portfolio assets − present value of the pension liabilities

funding ratio = market value of assets / present value of liabilities

A pension plan is fully funded if the funding ratio = 1 (which means the plan surplus is 0). An underfunded plan has a funding ratio less than 1, and an overfunded plan has a funding ratio greater than 1.

The characteristics of the pension liability drive the return and risk requirements of the investment portfolio and ultimately the asset allocation decision. Furthermore, the analysis should recognize that the value of the assets and the liabilities are driven by some of the same factors, so the correlations between changes in value of the two are important.

LOS 19.j: Describe and evaluate characteristics of liabilities that are relevant to asset allocation.

CFA® Program Curriculum, Volume 3, page 267

The following characteristics of liabilities are relevant to the asset allocation decision:

- Fixed versus contingent: Fixed liabilities have cash flows whose amount and timing are specified in advance, such as a fixed-rate corporate bond. Contingent liabilities have cash flows that depend on uncertain future events, such as the pension liability associated with a defined pension plan.
- Legal versus quasi-legal: Legal liabilities are obligations defined in a legal agreement. Quasi-legal liabilities are not legal obligations but are cash outflows expected to occur in the future and are essential to the mission of the institution. University endowments can be considered to have quasi-legal liabilities.
- Duration and convexity measure the change in value of a liability for a given change in interest rates. In the CFA curriculum, we typically talk about duration

and convexity in relation to fixed-income securities, but the concept can be applied to any liability.

- Liability value versus size of sponsoring organization: A large liability in relation to the size of the sponsoring organization will necessarily be accounted for in the asset allocation decision; a small liability can usually be ignored as its effect on the optimal asset allocation is minimal.
- Factors that affect future cash flows: These factors include inflation, interest rates, risk premiums, and other economic conditions. DB pension obligations are influenced by the choice of the discount rate, for example.
- Timing considerations, including longevity risk.
- Regulations affecting the determination of the liability's value, typically found in the insurance industry.

LOS 19.k: Discuss approaches to liability-relative asset allocation.

LOS 19.l: Recommend and justify a liability-relative asset allocation.

CFA® Program Curriculum, Volume 3, page 270

We will discuss three approaches to liability-relative asset allocation. They are summarized here and then discussed in more detail:

- Surplus optimization: This is an extension of MVO in which we determine an efficient frontier based on the surplus with its volatility as our measure of risk, stated either in money or percentage terms.
- Two-portfolio approach: In this approach, we separate the asset portfolio into two subportfolios: a hedging portfolio and a return-seeking portfolio.
- Integrated asset-liability approach: This approach integrates both the assets and the liabilities in a joint optimization method.

Surplus Optimization

We can define the surplus return as:

$R_{s,m}$ = surplus return = (change in asset value − change in liability value) / initial asset value

Then the objective function to maximize is:

$U_m = E(R_{s,m}) - 0.005 \times \lambda \times Var_{s,m}$

where:

$E(R_{s,m})$ = expected surplus return

$Var_{s,m}$ = variance of surplus return

We then proceed with the same MVO as previous, except we also include the expected returns and variances of the liabilities. The correlations reflect the extent to which the assets are useful to hedge the liabilities.

There are a number of ways to estimate the expected returns and variances of the liabilities. The first is to make the assumption that the liabilities behave like corporate bonds and the liability inputs can be estimated using the expected return and volatility of corporate bonds. The second is to use a factor approach and identify the common factors that affect both the asset classes and the liabilities.

Two-Portfolio Approach (Also Known as the Hedging or Return-Seeking Approach)

Conceptually this is a straight-forward approach. We create an asset portfolio that hedges the liabilities, and the remainder is managed independently using MVO to maximize utility and identify the optimal risk-return tradeoff.

The hedging portfolio can be created using the various techniques outlined elsewhere in the Level III curriculum fixed-income readings: cash flow matching, duration matching, and immunization.

This approach is most often used for insurance companies and overfunded pension plans that want to minimize the risk of underfunding.

This approach can be modified by (1) only partially hedging the liabilities and allocating more capital to the return-seeking portfolio or (2) increasing the allocation to the hedging portfolio as the funding ratio and the surplus increase. Both of these approaches are more aggressive than completely hedging the liabilities, as they trade off higher expected return for higher risk.

There are two limitations of this approach:

- If the funding ratio is less than one, it's difficult to create a hedging portfolio that completely hedges the liabilities.
- A hedging portfolio may not be available to hedge certain kinds of risk (like earthquakes).

Integrated Asset-Liability Approach

The distinctive feature of the previous two approaches is that the composition of the liabilities is already in place when the asset allocation decisions are made, so the two decisions are made independently. Banks, hedge funds with short positions, and insurance companies, however, make decisions about the composition of their liabilities jointly with their asset allocation decisions. There is a continuous feedback loop between the two, which requires a multiperiod model. This is often referred to as an integrated asset-liability approach.

For example, a key risk faced by large global banks, which are very highly leveraged, is whether the bank's capital is sufficient to absorb losses when their asset values decline, their liability values increase, or both. And as both bank assets (loans) and liabilities (deposits) are affected by changes in interest rates, although to varying degrees, stress testing requires a framework that can simultaneously account for both sides of the balance sheet. An integrated asset-liability approach is therefore necessary for banks to identify the optimal mix of assets and liabilities to meet their return and risk objectives.

MODULE QUIZ 19.6

To best evaluate your performance, enter your quiz answers online.

1. Which of the following items is *best* described as a contingent liability?
   A. A company's fixed-coupon debt.
   B. An insurance company's obligations to pay policyholders.
   C. Planned distributions by a foundation.
2. A bank is *most likely* to use which of the following approaches to liability-relative asset allocation?
   A. Surplus efficient frontier approach.
   B. Integrated asset-liability approach.
   C. Two-portfolio approach.

MODULE 19.7: GOALS-BASED AND MISCELLANEOUS APPROACHES

LOS 19.m: Recommend and justify an asset allocation using a goals-based approach.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 283

The **goals-based approach** to asset allocation is useful for individual investors, who typically have a number of (sometimes conflicting) objectives, with different time horizons and different levels of urgency, which we will measure as specified required probabilities of success. For example, an individual investor might define one goal as saving enough for college tuition in 10 years and specify that she requires a 90% probability of success, while another goal is having $1,000,000 in 30 years to set up a foundation when she retires, with a 60% probability of success. The first goal in this case is more urgent than the second goal.

In this approach:

- The investor's portfolio is composed of subportfolios, and each investment goal is addressed individually with these subportfolios.
- Taxable and tax-exempt investments are part of the opportunity set.
- Instead of expressing an investment goal as an expected average return on the portfolio, we identify and document "minimum expectations" for each goal, which is the minimum expected return necessary to provide a specified minimum required probability of success over the given time horizon.

Often, the advisor will select from a set of pre-established subportfolios (modules) to meet specific goals of a client rather than create new subportfolios for each client. The modules are distinguished by differences in risk-return tradeoffs, liquidity requirements, and the inclusion or exclusion of certain asset classes.

The asset allocation is determined by identifying, for each goal, the module that provides the highest expected return with the specified probability of success over the required time horizon. Then the size of the investment in that module is simply the present value of the future goal discounted at the expected return of that module. The portfolio allocation is then the sum of all of the individual investments necessary to achieve each goal.

EXAMPLE: Goals-based approach

An investor has a goal of having $500,000 to fund his daughter's undergraduate and graduate education beginning in 10 years with a 90% required probability of success. He also has a goal of transferring $6,000,000 to his daughter in 30 years with a required probability of success of 75%.

The modules in the table are available to the adviser to implement each of these goals.

	Module A	Module B	Module C
Expected return	5%	6%	8%
Expected volatility	4%	7%	14%

The annual minimum expected returns at various probabilities of success over the 10-year time horizon are as follows:

Required Success	Module A	Module B	Module C
90%	3.0%	2.4%	–2.2%
75%	3.6%	3.8%	1.7%

The annual minimum expected returns at various probabilities of success over the 30-year time horizon are as follows:

Required Success	Module A	Module B	Module C
90%	4.0%	4.3%	4.7%
75%	4.1%	4.8%	5.2%

各目标下，
对应成功概率
收益最大的
--不考虑波动率

Determine the module to use and **calculate** the amount to invest in that module to meet each goal. Treat each goal separately.

Answer:

For the first goal, Module A has the highest expected return given a 90% required probability of success of 3.0% over the 10-year time horizon. The investment necessary today in Module A to fund the $500,000 college tuition in 10 years is the present value of $500,000 discounted at 3.0% for 10 years, or $372,047.

For the second goal, Module C has the highest expected return given a 75% required probability of success of 5.2% over the 30-year time horizon. The investment necessary today in Module C to

> fund the $6,000,000 transfer in 30 years is the present value of $6,000,000 discounted at 5.2% for 30 years, or $1,311,231.

LOS 19.n: Describe and critique heuristic and other approaches to asset allocation.

CFA® Program Curriculum, Volume 3, page 300

There are additional approaches to optimal asset allocation that are ad hoc and not based on theoretical models and don't require sophisticated mathematics, but also don't necessarily lead an optimal allocation in the way in which we have defined it up to this point.

120 Minus Your Age

This one is easy. It relates your age to your allocation to equities so that 120 − age = % allocation to equities, with the remainder going to fixed incomes. That means a 40-year-old woman would have an 80/20 split between stocks and bonds, and when she is 50, it would be 70/30.

It's consistent with the idea that as the value of human capital declines as we age, our capacity to bear risk in the rest of the portfolio declines, suggesting that we move from equities into fixed incomes. What's interesting about this approach is that it seems to come close to mimicking the allocations of target-date retirement funds.

60/40 Split

This one is even easier than the 120-minus-your-age rule. You simply maintain your asset allocation at 60% stocks and 40% bonds. This is not nearly as off-the-wall as it sounds, as the global financial asset portfolio has historically been split approximately 60/40 between stocks and bonds.

PROFESSOR'S NOTE

I guess the assumption with this method is that you are 60 years old throughout your entire life!

Endowment Model or Yale Model

Under this approach, you allocate larger amounts to alternative investment asset classes (private equity, real estate, or natural resources) than is typically recommended by a strict MVO. Presumably these markets are less-than-perfectly informationally efficient, so investment managers with expertise in these markets can outperform expectations. Also, they are less liquid, and certain institutional investors are positioned to take on additional liquidity risk in return for a liquidity premium because of their longer time horizons. The approach is popular with university endowment funds.

Risk Parity

The idea with the risk parity asset allocation approach is that diversification is achieved by ensuring that each asset class contributes the same amount to the total portfolio risk. This addresses critique 4 of MVO that diversification across asset classes does not guarantee diversification across risk sources. The criticism of this approach is that it ignores expected returns and focuses only on risk.

1/N Rule

If we create an equally weighted portfolio in which we allocate the same percentage to each asset class, we have in effect weighted each class by 1/N, where N is the number of classes. For example, with 8 asset classes, this approach suggests we invest 1/8 = 12.5% in each class. One common method is to rebalance to equally weighted each quarter. Although it sounds very simple, there is some empirical evidence that this type of approach actually performs better than we would expect.

MODULE 19.8: REBALANCING POLICY

LOS 19.o: Discuss factors affecting rebalancing policy.

CFA® Program Curriculum, Volume 3, page 305

Video covering this content is available online.

Investment managers rebalance portfolios for a number of reasons, including in response to changing client goals and capital market expectations or changes in tactical allocations. Here we will stick to the CFA curriculum definition: adjusting asset allocations to move toward the originally defined strategic allocation goal. Percentagerange rebalancing involves setting trigger points around the optimal percentage allocation and rebalancing back to the target allocation or partially correcting when those trigger points are hit.

The key factors that impact the optimal corridor width (or the rebalancing range) of an asset class include transaction costs, risk tolerance, correlations with the rest of the portfolio, and the volatility of the rest of the portfolio.

The higher the transaction costs, the wider the optimal corridor, as the benefits of rebalancing have to "pay" for higher costs to rebalance. The higher the investor's risk tolerance, the wider the corridor, because the investor is less concerned about deviations from the optimal allocation. The higher the correlation of the asset class with the rest of the portfolio, the wider the corridor, because a portfolio tends to move with the asset class, and the allocations tend to stray more slowly from the target. Finally, the higher the volatility of the asset classes, the narrower the optimal corridor. This is because higher volatility increases the likelihood that the actual allocation will diverge over time from the target allocation.

Ultimately, the choice of corridor width depends on a trade-off between risk control, transaction costs, and correlations between classes. In complex situations, a quantified cost-benefit analysis will be required.

MODULE QUIZ 19.7, 19.8

To best evaluate your performance, enter your quiz answers online.

1. Which of the following statements regarding subportfolios within the context of the goals-based approach to asset allocation is *most accurate*?
    A. The most significant difference between the subportfolios is the return-risk tradeoff.
    B. Higher priority goals require higher return assets.
    C. The size of the investment in a particular subportfolio is the present value of the future goal discounted by the risk-free rate.
2. Which of the following statements regarding the "120 minus your age" heuristic is *most correct*?
    A. A 70-year old individual should have 50% of the investment portfolio invested in equity securities.
    B. A 60-year old individual should have 60% of the investment portfolio invested in fixed-income securities.
    C. The approach generally does a poor job of mimicking the allocations of target-date retirement funds.
3. A portfolio has invested in asset class Z and the manager is setting the optimal rebalancing corridor. The corridor will be wider if:
    A. the rest of the portfolio is highly volatile.
    B. the correlation of Z with the rest of the portfolio is highly positive.
    C. transaction costs are low.

KEY CONCEPTS

LOS 19.a

Given an opportunity set of investable assets, their expected returns and variances, as well as the pairwise correlations between them, MVO identifies the portfolio allocations that maximize return for every level of risk. If we assume the opportunity set includes all assets, the result is the efficient frontier.

MVO is criticized for:

1. **GIGO:** The quality of the output from the MVO (portfolio allocations) is highly sensitive to the quality of the inputs.
2. **Concentrated asset class allocations:** MVO often identifies efficient portfolios that are highly concentrated in a subset of asset classes.
3. **Skewness and kurtosis:** These are ignored.
4. **Risk diversification:** MVO identifies an asset allocation diversified across asset classes, but not necessarily the sources of risk.
5. **Ignores liabilities:** MVO also does not account for the fact that investors create portfolios as a source of cash to pay for something in the future.
6. **Single-period framework:** MVO is a single-period framework that does not take into account interim cash flows or the serial correlation of asset returns from one time period to the next.

LOS 19.b, 19.i

MVO provides an efficient frontier of asset allocation choices. However, the allocation selected will depend on the specific investor:

- How do they quantify return to risk?
- Do they require specific assets or asset classes to be excluded or included?
- Do they use an asset-only, liability-relative, or goals-based approach?

Variations on MVO may be used:

- Resampling uses multiple sets of inputs to make the final result less dependent on initial assumptions and typically results in more asset classes being included in the portfolio.
- Reverse optimization solves for expected return by asset class based on the classes' weights in the world market portfolio and uses those consensus return expectations to determine asset allocation for an investor.
- Black-Litterman allows the manager to view adjust those consensus return expectations.
- MCS complements MVO; MCS is covered later.

LOS 19.c

A significant portion of the typical investor's asset portfolio is human capital and also the residential real estate property the investor owns and lives in. We can adapt the MVO framework to incorporate these kinds of assets into the analysis by estimating the expected return and risk inputs for these assets and constraining the allocations to match current values.

LOS 19.d

Less-liquid asset classes like direct real estate, infrastructure, and private equity require a liquidity return premium to compensate the investor for the additional liquidity risk.

LOS 19.e

The goal of risk budgeting is to maximize return per unit of risk, where we can define risk as total portfolio risk, active risk, or residual risk.

LOS 19.f

Ways to incorporate client risk preferences into asset allocation include:

- Specifying additional constraints.
- Specifying a risk aversion factor for the investor.
- Using Monte Carlo simulation.

LOS 19.g

Monte Carlo simulation can be used to (1) address the limitations of MVO as a single-period model and the related issues of rebalancing and taxes in a multiperiod framework and (2) guide individual investors to identify their risk tolerance level.

LOS 19.h

Investment factors can be used in asset allocation by defining the opportunity set as risk factors that affect expected return. Such factors include market exposure, size, valuation, momentum, liquidity, duration, credit, and volatility.

LOS 19.j

The following characteristics of liabilities are relevant to the asset allocation decision:

- Fixed versus contingent.
- Legal versus quasi-legal.
- Duration and convexity.
- Liability value versus size of sponsoring organization.
- Factors that affect future cash.
- Timing considerations.
- Regulations affecting the determination of the liability's value.

LOS 19.k, 19.l

There are three common approaches to liability-relative asset allocation.

- Surplus optimization: Use MVO to determine an efficient frontier based on the surplus with its volatility as our measure of risk, stated either in money or percentage terms.
- Two-portfolio approach: Separate the asset portfolio into two subportfolios: a hedging portfolio and a return-seeking portfolio.
- Integrated asset-liability approach: Jointly optimize the selection of both the assets and the liabilities.

LOS 19.m

The goals-based approach is useful for individual investors, who typically have a number of (sometimes conflicting) objectives, with different time horizons and different levels of urgency.

- The investor's portfolio is composed of subportfolios, and each investment goal is addressed individually with these subportfolios.
- Taxable and tax-exempt investments are part of the opportunity set.
- Minimum expectations are specified for each goal.

LOS 19.n

Additional ad hoc approaches to asset allocation include:

- 120 minus your age.
- 60/40 split.
- Endowment model or Yale model.
- Risk parity.
- 1/N rule.

LOS 19.o

The following indicate wider corridors for asset classes:

- Higher transaction costs.
- Higher investor risk tolerance.
- Higher correlation of the asset class with the rest of the portfolio.
- Higher volatility of asset classes indicates a narrower corridor to control risk.

Ultimately, the choice of corridor width depends on a trade-off between risk control, transaction costs, and correlations between classes. In complex situations, a quantified cost-benefit analysis will be required.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 19.1, 19.2, 19.3

1. **A** Reverse optimization is most likely to produce a more diversified portfolio because it starts with the weights of all assets in the global world market portfolio and solves for the consensus expected returns consistent with that highly diversified portfolio. MCS does not address this issue at all because it is used to model behavior over time of any one specific asset allocation. Liability-relative MVO is focused on the change in value of the surplus (PVA − PVL). Resampled MVO is another way to address the concentration issue, but that was not a choice. (Module 19.2, LOS 19.a)

2. **C** Step 1 is to exclude any portfolios that do not meet the 4% minimum return objective. Next, calculate the certain equivalent returns:

   Allocation 1: 0.06 – (0.5 × 2 × 0.02) = 0.04

   Allocation 2: 0.08 – (0.5 × 2 × 0.03) = 0.05

   Allocation 3: 0.10 – (0.5 × 2 × 0.04) = 0.06

   Allocation 3 has the highest certainty-equivalent return, so it should be chosen by Cullis. (Module 19.1, LOS 19.a)

3. **C** Step 1 is to exclude any portfolios that do not meet the 4% minimum return objective. Next, calculate the safety-first ranking to determine highest probability of exceeding the 4%:

   Allocation 1: $(0.06 – 0.04) / (0.02)^{1/2} = 0.141$

   Allocation 2: $(0.08 – 0.04) / (0.09)^{1/2} = 0.133$

   Allocation 3: $(0.10 – 0.04) / (0.16)^{1/2} = 0.150$

   Allocation 3 has the highest probability of exceeding the threshold return. (Module 19.3, LOS 19.i)

Module Quiz 19.4

1. **B** She is young, starting a job, and apparently debt free. A high ability to take risk is plausible. She appears to have no financial capital, so human capital (the new job) appears to be her only capital. Her HC is somewhat riskier and uncertain, so not at all like an inflation-linked bond, which would require her income to be linked directly to changes in inflation. (LOS 19.c)

2. **B** Ignoring the positions and running MVO for the rest of the client's portfolio is a method of dealing with such preexistent positions. This essentially recognizes the client will not sell such positions. Two other methods exist. Include the positions in MVO by (1) modeling the specific characteristics of what that client actually

owns, or (2) using data on public funds but realizing that such data will not reflect the specific characteristics of the client's positions. However, you cannot use public data to model the highly specific characteristics of what the client owns. Also, a liquidity premium increases expected return. (LOS 19.d)

3. **B** The reading lists three methods: specifying additional constraints, specifying a risk aversion factor for the investor, and using MCS. (LOS 19.g)
4. **C** In a single-period model, taxes are easy to incorporate into the analysis, and rebalancing the portfolio is irrelevant. Therefore, MVO can address taxes in a single-period model and MCS is not necessary. MCS becomes useful in dealing with a multi-period framework, where the analysis of taxes and rebalancing becomes much more mathematically challenging otherwise.

   MCS *complements* (does not replace) MVO by addressing the limitations of MVO as a single-period framework.

   MCS tools can be quite different. They vary significantly in their ability to model non-normal returns, serial correlations, tax rates, and non-traditional investments, for example. (LOS 19.g)

Module Quiz 19.5

1. **C** $MCT_{Requities} = 1.19 \times 10\% = 11.9\%$

   Ratio of excess return to $MCT_{Requities} = 8.25\% / 11.9\% = 0.693$

   (LOS 19.e)
2. **C** Not all factors are replicable, but the ones that are can be obtained with a position that is long the desired factor (e.g., growth) and short the undesired factor (e.g., value). Neither asset class–based allocation nor factor-based allocation is superior. It is a matter of which method better resonates with how the manager looks at investing, not the kind of client. (LOS 19.h)

Module Quiz 19.6

1. **B** Insurance company obligations to policyholders are typically contingent (uncertain in timing, amount, or both) liabilities (a legal obligation to pay). Fixed-coupon debt is a fixed obligation to pay, and foundation distributions are not legal liabilities (but may be regarded as quasi liabilities). (LOS 19.j)
2. **B** A bank can typically vary the nature of both its assets and liabilities. A joint optimization (deciding how to set up both) is common. The other approaches take the liabilities as a given and only focus on managing the assets. (LOS 19.l)

Module Quiz 19.7, 19.8

1. **A** The priority of the goal determines the amount of risk taken. Thus, you expect significant differences in risk and return between subportfolios. The allocation to a subportfolio is the future need discounted by the expected return of the assets

used in that subportfolio, not by risk-free rates. High-priority goals require more certainty and would be funded by lower, not higher, risk and return assets. (Module 19.7, LOS 19.m)

2. **A** The percentage allocation to equities is based on 120 minus your age. Such an approach has been found to come close to mimicking the allocations of target-date retirement funds. (Module 19.7, LOS 19.n)

3. **B** High correlation allows wider corridors because if the assets move in sync, divergence between them is less likely. Low transaction costs allow narrower corridors because the cost of rebalancing is reduced. High volatility in either Z or the rest of the portfolio increases risk and calls for narrower corridors. (Module 19.8, LOS 19.o)

The following is a review of the Asset Allocation and Related Decisions in Portfolio Management (2) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #20.

READING 20: ASSET ALLOCATION WITH REAL-WORLD CONSTRAINTS

Study Session 10

EXAM FOCUS

Asset allocation is not an exercise in abstract math. This reading continues the discussion of practical considerations that may arise. Be prepared to recognize the potential impact of the issues discussed on a particular client's asset allocation.

MODULE 20.1: REAL WORLD ISSUES

LOS 20.a: Discuss asset size, liquidity needs, time horizon, and regulatory or other considerations as constraints on asset allocation.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 324

ADDITIONAL CONSTRAINTS WHEN CHOOSING AN OPTIMAL ASSET ALLOCATION

Asset Size

Smaller funds often lack the expertise and governance structure to invest in complex strategies, and therefore, often face a problem of how to achieve an adequate level of diversification. In addition, many capital markets impose local legislation, restricting investment in some assets to investors with a given level of capital or experience. Smaller funds may use commingled investment accounts (pooling money from a small group of investors) to achieve adequate size to diversify. To enable investment in assets where local legislation requires minimum investment levels, families may pool their assets to qualify.

Larger portfolios can generally access greater management expertise in the governance capacity, allowing them to consider complex strategies that smaller funds cannot. Their larger capital base also enables investment in accounts with relatively high minimum investment requirements. This allows large funds to achieve higher levels of diversification.

Large portfolios benefit from economies of scale via cost savings regarding internal management and greater negotiating power regarding management fees, allowing higher allocations to alternative investments. As the size of the fund increases, the *per-participant* cost of the internal governance infrastructure decreases, giving the fund a competitive advantage in private equity, hedge fund, and infrastructure investing.

Funds that are too large may not be able to take advantage of asset classes that lack the capacity to absorb large amounts of funds. For example, active equity strategies involving small-cap stocks may be less suitable because the size of investment can be too large for an external manager to take on. A small-cap manager may suffer diseconomies of scale as: larger trades have increased price impact, the inflow of capital may encourage managers to abandon their core strategies, and the need for increased numbers of staff may slow the decision-making process. A potential solution is to split the allocation among several managers, but identifying and monitoring suitable managers is an added burden and cost. The result is that large funds often take a passive approach in such situations.

Very large funds may find that there are not enough alternative investments (e.g., too few hedge funds) available and may choose a fund-of-funds (FoF). But this carries a double fee structure for the FoF manager and the underlying fund managers. In addition, the strategies of one hedge fund manager may be offset by strategies of another manager.

Liquidity Needs

The key to successfully addressing the liquidity constraint for a portfolio is to integrate the needs of the owner and the characteristics of the asset class. Some owners require extremely high levels of liquidity and hence typically invest in high-quality, short-term, liquid assets. Other owners with lower needs and much longer time horizons can take advantage of the illiquidity premium inherent in alternative investments, such as real estate and infrastructure.

The following table summarizes the typical liquidity needs of a range of portfolio owners.

Portfolio Owner	Typical Liquidity Needs
Banks	High liquidity needed to support day to day operations and stand ready to repay deposits
Sovereign Wealth Funds, Endowments, Pension Plans, Foundations	Longer time horizons and lower liquidity needs
Property and Casualty Insurance	Relatively high due to unpredictability of claims
Life and Auto Insurance	Relatively low due to predictability of claims
Individuals	Varies by individual circumstance

But there are always case-specific exceptions, such as a bank with highly liquid loan assets that can provide necessary liquidity that is normally provided by the investment portfolio or a foundation supporting research that requires high liquidity to fund potential but unpredictable breakthrough research opportunities.

The possibility of extreme market conditions should also be considered when planning liquidity levels. Investor behavior changes during times of stress, and a successful allocation should take account of the resulting change in cash flows. Portfolio governance is also important in this context. In times of stress, unsophisticated investors may panic sell assets, leading to permanent losses and lower total returns from the capital base when returns revert to precrisis levels.

Time Horizon

A portfolio's time horizon is defined by a liability to be paid or a goal to be funded at a future date. Asset allocations must consider the horizons defined by each liability and goal, as well as adapting to the changing mix of assets and liabilities as time progresses. The value of human capital, for example, declines over time. As a result, the asset allocation will likely shift towards lower risk asset classes such as fixed income.

The changing nature of liabilities over time also requires changes in asset allocation. A pension fund catering for a young workforce, for example, would be heavily invested in long-term bonds. A more mature scheme would move towards intermediate and short-term bonds.

The time horizon is also associated with the ability to take on risk. Portfolios with longer time horizons are often invested in assets with higher risk. There is evidence that risky asset returns mean revert over time, evening out below and above average levels of return. This concept is known as time diversification.

Asset allocations for individual investors also change over time, as illustrated in the following examples.

> **EXAMPLE: Older retired individual**
>
> Barry Garland is 70 years old and recently retired. He has two goals that require funding from his current portfolio:
>
> - Goal 1: To maintain a constant standard of living to age 85.
> - Goal 2: To maintain a constant standard of living from age 85 to 100.
>
> Goal 1 is fully funded, but Goal 2 is only partially funded. Barry's life expectancy at age 70 is 17.5 years.
>
> Goal 1 will have the higher priority as his chances of living decline as he ages. Goal 1 is fully funded and higher priority so the subportfolio will emphasize more conservative investments.
>
> Goal 2 is of a lower priority and currently not fully funded. This subportfolio can be invested more aggressively with more growth potential.

> **EXAMPLE: Families with multiple funding goals**
>
> Jane and Arthur Bigstone are both 52 years old and work as lawyers in their home town. The Bigstones have a daughter, Alice, age 16, who they intend to send to college, and a son Mark, a promising young politician, age 27, who aims to run for mayor of the nearest city in 8 years. If their financial situation allowed it, they would like to make a donation to any campaign he ran. They would also like to set up a scholarship at the local school to fund talented children from

underprivileged neighborhoods. Ideally, they would like to do this when they are 80 years old to celebrate the 40th anniversary of Arthur setting up his own practice.

The Bigstones have 4 goals for their portfolio:

1. Funding lifestyle and consumption needs.
2. Funding Alice's college education.
3. Donating to Mark's mayoral campaign.
4. Funding the scholarship.

A typical allocation could split the lifestyle/consumption goal into a worst-case scenario of reduced standard-of-living, a baseline case maintaining standard-of-living, and an aspirational case where the standard-of-living improves. This would mean the Bigstones would have 6 subportfolios with risk preferences similar to those shown in Figure 20.1.

Figure 20.1: Subportfolios

Goals	Risk	Allocation	% of Total Portfolio
Minimum	Conservative	100% Bonds & Cash	65%
Maintain	Moderate	60% Equity & 40% Bonds	12%
Aspirational	Aggressive	100% Equity	8%
College Fund	Conservative	100% Bonds & Cash	6%
Campaign Donation	Aggressive	100% Equity	6%
Scholarship	Aggressive	100% Equity	3%
Aggregate		25% Equity & 75% Bonds	100%

In another 15 years, the allocation for the Bigstones would look very different. With fewer years of consumption to fund, the assets required to fund future consumption are much lower. The college and mayoral campaign have been funded and only the scholarship remains as an aspirational goal. The allocation may now look similar to Figure 20.2, assuming the goals as defined earlier have not changed. Clearly, as the Bigstone's children grow up and pursue careers, it is entirely possible that new goals (e.g., a run for congress for Mark) would replace the aspirational goal of the scholarship.

Figure 20.2: Subportfolios 15 Years Later

Goals	Risk	Allocation	% of Total Portfolio
Minimum	Conservative	100% Bonds & Cash	60%
Maintain	Moderate	60% Equity & 40% Bonds	10%
Aspirational	Aggressive	100% Equity	6%
Scholarship	Aggressive	100% Equity	24%
Aggregate		35% Equity & 65% Bonds	100%

PROFESSOR'S NOTE

It should be evident the specific allocations shown are somewhat arbitrary. There is no formula to determine the numbers. Your task is to see the logic behind choosing a higher or lower allocation to equity, bond, and cash in one subportfolio relative to another.

REGULATORY AND OTHER EXTERNAL CONSTRAINTS

Each portfolio faces its own set of regulatory and other external constraints. Several of these portfolios are addressed below.

Insurance Companies

Investment returns are a large contributor to the performance of an insurance company. The asset class with the largest allocation will be fixed income, reflecting the need for the insurer to match assets to the projected cash flows of the risks being insured. Local accounting laws often require fixed income investments to be stated at book value, so the insurer can focus primarily on the pattern of cash flow receipts rather than the volatility of market value.

The main risk considerations are the need to maintain enough capital to meet claims made by policyholders, along with factors that directly affect the company's financial strength metrics. These include:

- Risk-based capital measures.
- Liquidity.
- Yield levels.
- Credit ratings.
- Potential to liquidate assets to meet claims.

Local legislation often limits the allocation insurance companies can make to asset classes. Equity investment maybe limited to as little as 10%, with caps also placed on allocations to private equity investments and high-yield bonds.

Pension Funds

As well as capping the allocation to certain asset classes, local legislation often places a wide range of tax, accounting, reporting, and funding constraints on pension funds. There may be tax incentives offered to invest in domestic assets. Accounting rules may allow deferred recognition of losses.

These factors will be considered in the fund's decision on the level of risk exposure. The final asset allocation is likely to consider the anticipated funding cost, and the implication for the pension expense that is likely to be reported in the financial statements.

When considering funding as a constraint, the pension fund will compare the risk of funding cost exceeding a given threshold for the asset allocation (a risk the fund would like to minimize), to the present value of expected contributions (which the fund would also like to minimize).

For example, higher allocations to equities rather than bonds will increase the volatility of returns. In turn, this increases the risk that low returns increase the required contributions. However, there is a benefit in that the higher expected return would decrease the present value of expected contributions.

The fund will need to decide on the optimal combination of risk (that contributions exceed a given level) and return (as measured by the PV of expected contributions) whilst taking into account the external regulatory requirements and allocation limits.

Endowments and Foundations

Endowments and foundations are both assumed to have an infinite time horizon and are subject to very few regulatory constraints compared to other entities. In some countries, there may be a minimum required annual distribution or socially responsible investment required to maintain a tax-exempt status. The long time horizon usually allows investment in risky assets, but if the endowment is part of the funding of an organization, covenants placed on the organization by lenders may constrain the activities of the portfolio.

Sovereign Wealth Funds

Sovereign wealth funds are government-owned entities investing on behalf of the state, and are typically not looking to match assets and liabilities. They are, however, subject to scrutiny from the citizens of that state which may reduce the level of risk that their long time horizon would otherwise allow them to take on.

In addition, each fund self-governs by capping the allocation of funds to certain assets. The aim of these constraints may include:

- Minimum investment requirements in socially or ethically acceptable assets.
- Maximum investments in risky assets such as alternative investments.
- Limits on the investment allowed in certain currencies.

Investing in ethically acceptable assets involves considering environmental, social, and governance goals. This is usually not part of the initial asset allocation process. Rather, an allocation will be set aside and invested in acceptable assets.

LOS 20.b: Discuss tax considerations in asset allocation and rebalancing.

CFA® Program Curriculum, Volume 3, page 342

In the presence of taxation, pre-tax, after-tax risk, and return characteristics may be significantly different. For this reason, taxable entities should consider after-tax characteristics during the allocation process. Adjusting for taxes after allocations have been made may lead to suboptimal allocations.

Although each country has its own unique tax legislation, there are several common characteristics that should be noted.

- Interest income is usually taxed at a higher rate than dividends or capital gains, and often at progressively higher rates. As a result, tax-exempt bonds (such as munis in the United States) may form a large part of a taxable investor’s fixed income allocation.

- Dividends are usually taxed at a lower rate than interest. Some investors may invest in preferred stocks in place of bonds for this reason.
- Capital gains are usually taxed at a lower rate than income, and capital losses can be used to offset capital gains elsewhere in the portfolio.
- Certain investment accounts may be tax deferred or tax exempt. The least tax-efficient (most heavily taxed) assets should be placed in the most tax-advantaged accounts.

Taxes complicate the portfolio optimization process. Return and risk need to be considered on both a pre- and after-tax basis, although correlations will be unaffected by taxes.

> **EXAMPLE: After-tax return**
>
> An investor subject to income tax on interest earned at a rate of 40% is considering investing in a bond with a 5% coupon that is expected to be held to maturity. What return should the investor use as an input into the asset allocation process?
>
> **Answer:**
>
> As the investor is taxable, the after-tax return of 0.05(1 − 0.4) = 0.03 or 3% should be used.
>
> Equity returns include both dividend income and capital gains. Therefore, the after-tax calculation must adjust for income tax and capital gains tax.

> **EXAMPLE: Multi-step after-tax return calculation**
>
> An investor is subject to income tax at a rate of 30% on dividend income and 20% on capital gains. One potential investment under consideration is a stock with an estimated pre-tax return of 16%. Ten percent of this return is expected be realized in the form of dividend income and 90% as price appreciation (capital gains are assumed to be realized annually). What is the after-tax return to be used in the asset allocation process?
>
> **Answer:**

Pre-tax dividend income:	16% × 0.1	= 1.6%
After-tax divided income:	1.6% (1 − 0.3)	= 1.12%
Pre-tax capital gain:	16% × 0.9	= 14.4%
After-tax capital gain:	14.4% (1 − 0.2)	= 11.52%
After-tax return: 1.12 + 11.52		**= 12.64%**

When an asset has a cost basis (for tax purposes) that differs from the market value, it has an existing unrealized gain (cost basis is below market value) or loss (cost basis is above market value). Unrealized gains imply an embedded tax liability and losses imply an embedded tax asset. There are three potential ways in which the current market value may be adjusted to reflect the liability or asset.

1. Subtract the value of the embedded capital gains tax from the current market value of the asset as if it were to be sold today.

2. Assume the asset is to be sold in the future and discount the tax liability to its present value using the asset's after-tax return as a discount rate.
3. Assume the asset is to be sold in the future and discount the tax liability to its present value using the after-tax risk-free rate.

Risk, as measured by standard deviation, must also be adjusted in the presence of tax. Capital gains tax reduces the gains realized on price appreciation, and the ability to use capital losses to offset those gains also reduces the losses realized from price declines. A post-tax standard deviation should therefore be used as an input into the asset allocation process.

EXAMPLE: After-tax standard deviation of return

A security has an expected pre-tax standard deviation of 12% and is under consideration for purchase by an investor who suffers capital gains tax at a rate of 20%. What is the after-tax standard deviation?

Answer:

after-tax standard deviation = 12%(1 − 0.2) = 9.6%

The use of both after-tax returns and after-tax risk can have significant impacts on the efficient frontier. Notably, allocations to tax inefficient assets such as high yield bonds will usually decrease. Such assets can, however, still play a part in the optimal allocation assuming they have low correlations with other assets in the portfolio.

Portfolio Rebalancing

To maintain the strategic asset allocation, all portfolios must periodically rebalance. Taxable asset owners will realize taxable gains at each rebalancing, so they must balance the need to maintain the strategic asset allocation with the desire to avoid taxable gains through frequent rebalancing. 税->缩小收益缩小损失->波动小

Rebalancing should occur less frequently in taxable portfolios due to the reduction in volatility caused by taxation (while correlations remain unaltered). The acceptable rebalancing range after-tax can be calculated by first finding the allowable deviation from target: after-tax deviation = pre-tax deviation / (1 − t).

PROFESSOR'S NOTE

Be careful not to confuse the impact of taxes on after-tax standard deviation (of return) with the impact of taxes on allowable after-tax deviation from target weight for an asset class.

- Taxes cushion the pretax upside and downside of an asset's return and therefore **decrease** after-tax standard deviation of the asset (compared to its pretax standard deviation).

$$\sigma_{AT} = \sigma_{PT}\,(1 - t)$$

- Because taxes lower return volatility, they **increase** the allowable deviation from target allocation weight (compared to pretax deviation).

$$\text{deviation from target weight}_{AT} = \text{deviation from target weight}_{PT} / (1 - t)$$

EXAMPLE: Pretax vs. after-tax deviation from target allocation weight

> A tax-exempt investor's strategic asset allocation calls for a 40% investment in fixed income, ±5% for a range of 35–45%. If fixed income returns are subject to a 30% tax rate, **calculate** the equivalent after-tax rebalancing range.
>
> **Answer:**
>
> pretax allowable deviation from target weight = 45% − 40% (or 40% − 35%) = 5%
>
> post-tax deviation from target weight = 5% / (1 − 0.30) = 7.14% for a range of 32.86–47.14%

There are two strategies that can be employed to reduce the impact of taxation:

- Tax loss harvesting.
- Strategic asset location.

Tax loss harvesting involves deliberately realizing losses to offset gains elsewhere. Strategic asset location involves making the most efficient use of tax advantageous accounts. There are two types of accounts that offer tax advantages:

- Tax exempt accounts: assets in these accounts are not subject to taxation.
- Tax deferred accounts: assets can appreciate in these accounts tax free but are taxed upon distribution.

Assets placed in tax-exempt accounts need no adjustment to their market value before being included in the asset allocation process. However, the value of assets in tax-deferred and taxable accounts should be reduced by the tax burden.

The portfolio optimization process should consider both the asset classes available and the asset location. For example, if an investor has two accounts available: one taxable and one tax deferred—and two potential asset classes: fixed income and equities, the process should use four account types. It should use two for each asset class, depending on whether they are placed in the taxable or tax-deferred accounts.

The risk and return inputs for equities and fixed income assets to be located in the tax-deferred vehicle (which are allowed to grow tax-free) should be pre-tax. Risk and return inputs for each asset class to be located in the taxable vehicle should be after-tax.

Although liquidity needs for consumption should always be considered (e.g., assets allocated to pension accounts may not be accessible without incurring financial penalties), the following general rules should be applied when considering asset location:

- Assets subject to the lowest tax rates (typically equity) should be first allocated to taxable accounts.
- Assets subject to frequent trading and high tax rates should be allocated to tax-advantaged accounts.

MODULE QUIZ 20.1

To best evaluate your performance, enter your quiz answers online.

1. An extremely large fund seeking to make a large allocation to an asset class will *most likely* face a liquidity constraint when investing in:
   A. hedge funds.
   B. global equity.
   C. investment-grade bonds.

12.5/（1-20%）=15.625

2. A fund manager oversees a tax-exempt fund and a taxable fund. The strategic asset allocation for both funds is 60% equity and 40% fixed income, with an after-tax rebalancing range of ±12.5%, assuming a tax rate of 20%. The current allocation in both funds is 71% equity and 29% fixed income. Which of the following statements is *most accurate*?
   A. Only the tax-exempt fund is outside its applicable rebalancing range.
   B. Both funds are outside their respective rebalancing ranges.
   C. Neither fund is outside its applicable rebalancing range.

MODULE 20.2: ADJUSTING THE STRATEGIC ASSET ALLOCATION

LOS 20.c: Recommend and justify revisions to an asset allocation given change(s) in investment objectives and/or constraints.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 352

It is unlikely that the initial optimal asset allocation will be applicable for the entire lifetime of any portfolio. In practice, it is common to reevaluate the allocation annually or if a change in goals, constraints, or beliefs suggests it is required.

Change in Goals

For (some) institutions, the business cycle may trigger changes in goals.

A downturn in business, for example, may necessitate increased cash flows from the portfolio. For instance, as airlines face competition from low-budget competitors, and because of uncertain revenue streams, they may reduce the level or risk exposure in their pension fund in order to smooth the volatility of contributions. Pension funds themselves have faced increasing deficits in recent years, which also triggers a reexamination of the asset allocation.

Changes in personal circumstances for the individual investor will also impact the allocation decision. Changes in employment status or starting a family, could both impact an investor's willingness and ability to take on risk.

Change in Constraints

A change in any of the constraints discussed earlier in this reading would also necessitate a review of the current allocation. Examples include:

- Government regulations requiring increased distributions to maintain tax-exempt status.
- Large unexpected cash flows to cover one-off events.
- Increased funding requirements for the beneficiary of an endowment.
- Forced early retirement of an investor due to illness.

Any change in constraint that leads to a requirement for increased cash outflows is likely to necessitate a shift to more liquid assets. Conversely, a large inflow (such as a donation to a foundation) is likely to give the portfolio more flexibility to take on risk.

Change in Beliefs

The investment activities of the asset owner are guided by a set of principles, or beliefs. Just as with goals and constraints, there is no guarantee that these beliefs will not change over time.

For a portfolio run by an investment committee, for example, a change in the makeup of that committee could change beliefs. New members are typically walked through an asset allocation study to make sure they understand the investing approach that had been adopted.

Changes in the economic environment are also likely to have a major impact on the optimization process.

The key inputs when optimizing the asset allocation are expected returns, volatility, and correlation of assets. If macroeconomic forecasts for any major asset class change, then the optimal allocation will likely change. An allocation exercise undertaken in the interest rate environment pre-2008 would have very different expectations for fixed income performance than one undertaken post-2008.

Asset allocations may also change at predetermined dates without the need for a detailed reexamination. Target-date mutual funds, for example, adjust allocations for individual investors depending on their age. Such funds use a 滑翔道 *glide-path* and shift from equity to more conservative investments (nominal and inflation-protected bonds) as the target date of the fund approaches.

LOS 20.d: Discuss the use of short-term shifts in asset allocation.

CFA® Program Curriculum, Volume 3, page 358

The long-term asset allocation specified in an investment policy statement is known as the *strategic asset allocation (SAA)*. This represents the target asset weightings for the portfolio.

Short-term deviations, known as *tactical asset allocations (TAAs)*, are typically used to take advantage of cyclical conditions in the market or a perceived mispricing in a given asset class.

Objective

The objective of TAA is to increase risk-adjusted returns by exploiting these short-term opportunities. It should be noted that this strategy assumes short-term returns are predictable (rather than a random walk as for long-term returns), and its success is dependent on market or factor timing, not individual security selection. 只是择时，不是择股

The TAA will still take into account the risk constraint specified in the investment policy statement, but will not consider specific goals or liabilities.

考虑约束，但不管特定目标和负债

Constraints

The success of the TAA should be judged against the benchmark of the SAA. The size of deviations may often be limited to a range around this allocation. There may also be an allowable range of predicted volatility or a tracking error budget versus the SAA.

Evaluation

There are several common methods of measuring the success of a TAA decision.

- Comparing the Sharpe ratios under the TAAs and the SAAs.
- Calculating the information ratio or t-stat of the excess realized returns relative to the SAA.
- Comparing the realized risk and return of the TAA to portfolios lying on the SAA's efficient frontier. It may be less optimal than other portfolios on that frontier.
- Perform attribution analysis on the excess return to identify the contribution of specific under- or over-weightings.

Drawbacks

The use of TAA incurs additional trading costs and taxation in the case of taxable investors. Overweighting an asset class also concentrates risk within the portfolio and reduces diversification benefits.

Approaches to Tactical Asset Allocation

Discretionary

Discretionary TAA relies on qualitative interpretation of macroeconomic variables. A skillful manager will aim to enhance returns in a rising market and hedge risks in falling markets by successfully forecasting short-term deviations from expected returns for an asset class. A manager may use a combination of macroeconomic data, fundamental data, and sentiment indicators to assist with forecasting.

Macroeconomic data will focus on bond yields and credit spreads, monetary policy, GDP growth, earnings and inflation predictions, and other leading economic indicators. Fundamental data such as the deviation of P/E, P/B ratios and dividend yield from their historic means may also be used. Economic sentiment can be gauged using a consumer confidence index.

Market sentiment can be assessed using:

1. Margin borrowing: Increasing purchases on margin drives up prices and indicates investors are bullish, although if the level of margin buying gets too high, it can be a bearish sign and indicates investors are overenthusiastic.
2. Short interest (aggregate amount of short selling): This is essentially the opposite. Increasing short interest drives down prices and indicates investors are bearish, although very high levels could indicate the market is at or near a low.
3. Volatility indexes: These indicate the level of fear in the market. It can be calculated using the bid-ask spread on index options. It increases with more purchases of puts and decreases with more purchase of calls.

Although the range of data used in discretionary TAA is quantitative in nature, the individual manager decides which indicators to use and how to prioritize and interpret them.

A systematic approach takes a more quantitative view. It attempts to capture excess returns using strategies that have historically been predictable and persistent. Two of the main factors that may be exploited are value and momentum.

A value approach aims to exploit the excess return of value stocks over growth stocks. Value in equities is most commonly measured using dividend or cash flow yields. Shiller's earnings yield (E/P) uses a 10-year average inflation-adjusted earnings figure compared to market price. Value currencies may be identified using short-term interest rate differentials, and commodities may be identified using roll yields. Commodity markets in backwardation will provide positive roll yields to the long, and those in contango negative. Yield spreads over risk free rates can be used to identify value in fixed income.

A momentum strategy assumes that trends will persist, which is why recent price movements are used to indicate whether to overweight or underweight an asset class. Indicators used include:

- Most recent 12-month trend: a momentum strategy assumes this trend will persist for the next 12 months.
- Moving-average crossover: shorter-term moving averages crossing above longer-term moving averages indicate an uptrend and vice versa.

MODULE 20.3: BEHAVIORAL ISSUES

LOS 20.e: Identify behavioral biases that arise in asset allocation and recommend methods to overcome them.

CFA® Program Curriculum, Volume 3, page 363

Video covering this content is available online.

Behavioral biases can cause problems during the asset allocation process. An awareness that behavioral bias exists is crucial to dealing with every bias.

Loss aversion is a bias in which investors dislike losses more than they like gains. This makes it difficult for investors to maintain discipline when returns are negative. There is a strong temptation to alter the asset allocation. Goals-based investing can help overcome the loss aversion bias. Goals are prioritized and subportfolios are used. High priority goals are funded with less risky assets, and riskier assets can be used in each subportfolio as the goal priority declines. Risk analysis typically focuses on downside measures such as shortfall risk.

Illusion of control is a tendency to overestimate the ability to control events. Combined with overconfidence, it typically leads to investors failing to diversify, trading too frequently, or both. Some common signs of this bias include:

- Frequent trading and tactical allocation shifts in an attempt at market timing. Investors who correctly call the reversal of a trend have too much confidence in their ability to repeat.
- Active security selection by institutional investors who believe the level of resources at their disposal gives them superior asset selection skills.

- Above average use of short selling and leverage.
- Shifting asset allocations despite a lack of consensus opinion as an individual trustee believes they know better than the market.
- Concentrated positions that expose the portfolio to diversifiable risk.
- Use of biased risk and return forecasts in the asset allocation framework that result in allocations that are inappropriately different from the market portfolio.

To counter the illusion of control, the market portfolio derived from the basic CAPM mean-variance framework should be used as the starting point for the allocation, and shifts in allocation away from this position should be subject to a formal review process.

Mental accounting involves separating assets and liabilities into different "buckets" based on **subjective criteria**. Mental accounting often leads to suboptimal asset allocations and less chance of meeting the goals. Individuals, for example, may spend their tax refund on luxury goods even when their savings are inadequate, or they may maintain low-interest savings accounts while paying high interest on large credit card balances. Entrepreneurs may form an emotional attachment to a company they founded and irrationally hold it in their high risk aspirational risk bucket, even when they no longer have any control at the company. Goals-based investing can help overcome mental accounting bias.

PROFESSOR'S NOTE

Notice that mental accounting is not the same thing as goals based even though goals-based investing has some elements of mental accounting in it. Goals-based investing is primarily a rational effort to differentiate the priority of goals and then use subportfolios in an effort to increase the chances of meeting the goals.

Representative bias, or *recency bias*, occurs when investors attach more importance to recent data than old data. The most common result is for an investor to shift allocations towards assets that have performed well recently. The popularity of purchasing and "flipping" (planning to sell it quickly at a profit) real estate property in the 1990s, can be traced back to a generation who had only experienced rising house prices. The problem was the past trend can and did change. Strong governance and objective asset allocation process are the best methods of defense against representative bias.

Framing bias occurs when the way information is presented affects the resulting decision. This is a common problem in asset allocation. If risk is presented as standard deviation, most investors prefer the lower risk. But downside risk measures may be more useful in specific situations. These include:

- VaR indicates amount of loss at some probability over a time.
- Conditional VaR quantifies the average loss within the VaR tail.
- Shortfall probability directly states the probability of some adverse outcome occurring.

The best way to overcome framing bias is to provide a full range of relevant information and not selectively frame only some pieces of the information.

Availability bias occurs when personally experienced or more easily recalled events disproportionately influence decisions. For example, an investor who suffered significant losses when the tech bubble burst won't buy tech or high P/B ratio stocks ever again. Investors make availability bias mistakes if they benchmark their portfolio performance to that of other investors, without regard to whether those other investors have comparable goals and constraints.

- *Familiarity bias* may be considered an offshoot of availability in that what is familiar or easy to recall is given too much importance in the decision process.
- *Home bias* can be considered another offshoot and is often seen in portfolios that over allocate to domestic securities, missing the opportunity to diversify with international securities.

Starting the allocation process with the global market portfolio can help to mitigate availability biases in the asset allocation process.

Investment Governance

Effective governance is essential to keeping behavioral bias under control. An effective framework should incorporate:

- Clearly stated long-term and short-term objectives.
- Logical allocation of responsibility for asset allocation decisions based on skills and workload.
- Documented processes for developing and approving the investment policy statement.
- Documented process for developing and approving the strategic asset allocation.
- Framework to monitor and report performance relative to specified goals and objectives.
- Periodic audits.

MODULE QUIZ 20.2, 20.3

To best evaluate your performance, enter your quiz answers online.

1. A target date mutual fund being used by an individual with a goal of retiring at age 65 will *most likely*:
   A. increase the allocation to inflation-protected bonds later in the glide path.
   B. have a larger allocation to nominal bonds earlier in the glide path as opposed to later.
   C. allocate more of the portfolio to cash in the early phases of the glide path.
2. Which of the following statements regarding the relative success of a tactical asset allocation (TAA) against the strategic asset allocation (SAA) is *most likely* correct?
   A. The TAA is successful if it has a positive Sharpe ratio.
   B. The TAA is unsuccessful if the information ratio is negative.
   C. The TAA is successful if it has a lower standard deviation than that of the SAA.
3. Ellie Rotheram is a 42-year-old real estate broker. Through patient saving, she has accumulated a retirement portfolio worth $720,000. Her investment approach is very conservative, with 88% allocated to fixed income and 12% to equity. She does not want to take the higher risk of equity in this retirement portfolio.

Recently, Rotheram inherited $500,000 and placed this in a separate portfolio. She realizes she has been very conservative in her retirement portfolio and plans to invest this portfolio more aggressively, in an effort to improve her lifestyle. So far, she has invested $225,000 in real estate investment trusts with holdings in her home state. She also invested $50,000 in the equity of a property development company, because she used to work there several years ago.

Which of the following behavioral biases is Rotheram *most clearly* exhibiting?

A. Mental accounting.
B. Familiarity bias.
C. Framing bias.

KEY CONCEPTS

LOS 20.a

Portfolios that are too small may be unable to invest in alternative investment vehicles that have minimum investment or qualification requirements.

Large portfolios have the skill, governance structure, and capital resources to invest in complex strategies and achieve diversification levels that smaller portfolios may be unable to achieve.

Portfolios that are too large may find it difficult to invest in niche strategies as the asset pool or managers available are quickly exhausted.

The asset owner's liquidity needs should be matched to the liquidity characteristics of an asset when optimizing asset allocation.

Investor behavior often changes during periods of negative returns, so any liquidity analysis should include an evaluation of liquidity requirements in times of market stress.

Longer time horizons typically allow for greater risk exposure due to the time diversification of risk.

Changes in goals, liabilities, and human capital as time passes mean the asset allocation process is a dynamic one that must be regularly revisited.

LOS 20.b

Investors subject to regulatory and tax requirements must factor those constraints into the asset allocation process.

Taxation reduces the risk and return of assets but leaves asset correlations unaltered.

Lower after-tax risk levels lead to wider rebalancing ranges for taxable investors. Frequent rebalancing leads to realized taxable gains.

Assets taxed at higher effective rates should be allocated first to tax advantaged accounts.

LOS 20.c

Asset allocations should be reviewed in the light of changing goals, beliefs, or other constraints.

Asset allocations may change automatically along a predetermined glide path in reaction to milestones or predictable events that change an investor's risk ability and willingness to take risk.

LOS 20.d

Short-term alterations to the long-term strategic asset allocation are known as tactical asset allocations (TAAs). The permitted size of alterations is likely to be dictated by the investment policy statement.

TAAs aim to enhance returns by altering asset classes, sectors, or risk-factor premium weightings.

The performance of TAAs can be measured by comparing realized portfolio results with TAA implemented to what would have happened under strategic asset allocation (SAA). Success is indicated by a better Sharpe ratio, information ratio, or t-stat of the excess returns. Actual TAA results that plot on the efficient frontier also indicate success.

TAAs can result in excessive trading and tax costs and in the concentration of risk in specific assets in the portfolio.

Systematic TAA uses quantitative signals to dictate shifts in weightings, whereas discretionary allocation relies on qualitative interpretation of data and manager skill in identifying shorter-term trends.

LOS 20.e

- Loss aversion occurs when a dislike of losses and preference for gains distorts rational decision making. Use goals-based investing to mitigate.
- Illusion of control is an overestimation of ability to control events. Start with the CAPM market portfolio and use sound corporate governance to mitigate.
- Mental accounting subjectively (not rationally) treats different pools of funds differently and often leads to suboptimal asset allocation. Use goals-based investing to mitigate.
- Representative (recency) bias overemphasizes the importance of the most recent events and can lead to trend following, assuming what is currently happening will continue. Use sound corporate governance to mitigate.
- Framing bias can result in suboptimal decisions when the way information is presented affects the decisions made. Start with a full range of relevant information to mitigate.
- Availability, familiarity, and home bias are closely related. What is easily recalled or available is given too much importance in the decision process. Start with the CAPM market portfolio to mitigate.

A strong governance process guards against most behavioral biases and should include clearly defined objectives (short and long term), responsibilities, and decision-making process along with a framework for monitoring, reviewing, and performing periodic internal audits.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 20.1

1. **A** Hedge funds are likely the smallest and least liquid class of the three choices. (LOS 20.a)

2. **A** The after-tax rebalancing deviation specified is 12.5% using a tax rate of 20%. The pretax deviation is therefore 12.5% × 0.8 = 10%. This means the tax-exempt portfolio is outside its applicable range. The range for the tax-exempt fund is 50% to 70% for equity and 30% to 50% for FI. The range for the taxable fund is 47.5% to 72.5% for equity and 27.5% to 52.5% for FI. Note that the effect of taxes on allowable deviation from target allocation weight was directly covered in our write up.

   $$\text{deviation from target weight}_{AT} = \text{deviation from target weight}_{PT} / (1 - t)$$

   In this case, you must work from deviation AT backwards to deviation PT, so the relationship is:

   $$\text{deviation from target weight}_{AT} (1 - t) = \text{deviation from target weight}_{PT}$$

   (LOS 20.b)

Module Quiz 20.2, 20.3

1. **A** Target date funds are intended for individuals who plan to retire on the fund's target date. The glide path ends on the target date. As the fund moves from early to late on the glide path, the asset allocation is shifted from equity towards more fixed income and cash. (Module 20.2, LOS 20.c)

2. **B** None of these are perfect answers in that we'd like to know how return to risk for the fund after TAA compares to what would have happened if the SAA (no TAA) had been followed. A negative IR certainly indicates failure as the goal of TAA is positive value added (the numerator of the IR ratio should be positive not negative). A positive Sharpe ratio alone says nothing about how SAA would have done, and lower risk with no idea of return earned provides little information. (Module 20.2, LOS 20.d)

3. **B** She exhibits familiarity bias when investing in equity of a company because she used to work there and a REIT because it has holdings in her home state. She is also using goals-based investing and while that has elements of framing in it, the motivations are quite different. Using subportfolios to address different priority goals can be quite rational and is not by itself a bias. There is no indication that framing of information is a factor here. (Module 20.3, LOS 20.e)

The following is a review of the Asset Allocation and Related Decisions in Portfolio Management (2) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #21.

READING 21: CURRENCY MANAGEMENT: AN INTRODUCTION

Study Session 10

EXAM FOCUS

Globalization of financial markets is an important topic in portfolio management and for the CFA exam. This section reviews currency math and then discusses an extensive list of currency management tools and techniques.

MODULE 21.1: MANAGING CURRENCY EXPOSURE

INTRODUCTION

Video covering this content is available online.

PROFESSOR'S NOTE

Good technique always matters but particularly with currency. This material emphasizes (1) thinking of a currency quote as a base currency in the denominator and a pricing currency in the numerator, and (2) being prepared to interpret a currency quote from the perspective of either the base or pricing currency.

This assignment is new as of the 2014 exam. It consolidates and replaces several other readings and follows some conventions you may not have seen before. Our introduction is longer than usual and is important. It is drawn from material marked optional or included later in the CFA text and you will need it to understand the assignment.

The Price and Base Currencies: The **base currency** is the denominator of the exchange rate and it is **priced** in terms of the numerator. Unless clearly identified otherwise, the terms "buy" and "sell" refer to the base currency. But remember, there are two currencies involved. For example, sell spot 1,000,000 at CAD/USD 0.9800 is assumed to mean sell for "immediate delivery" 1,000,000 U. S. dollars and buy 980,000 Canadian dollars. (The convention is settlement in two business days but this detail is ignored in most cases; the FX swap is an exception where the two business days are considered).

Buy 500,000 USD/CHF six months forward at 1.07 is assumed to mean buy 500,000 Swiss francs, settling in six months versus sell USD 535,000.

Bid/Asked Rules: Currencies are quoted with a **bid/offered** or **bid/asked price**. By convention, the smaller number is written first and the larger number is second. However, both the bid and the asked can be interpreted as the sale of one currency versus the purchase of the other currency. The difference is the dealer's profit margin to buy or sell the currencies. The customer pays the bid/ask spread, paying more and/or receiving less in the transaction. A quote of 0.9790/0.9810 CAD/USD has four interpretations.

Deliver more CAD can be phrased as:

- Buy 1.0000 USD and deliver (sell) 0.9810 CAD.
- Sell 0.9810 CAD and receive (buy) 1.0000 USD.

Receive less CAD can be phrased as:

- Sell 1.0000 USD and receive (buy) 0.9790 CAD.
- Buy 0.9790 CAD and deliver (sell) 1.0000 USD.

Spot Versus Forward: Spot exchange transactions are for immediate settlement and a **forward transaction** is a price agreed to on a transaction date for delayed (longer than spot) settlement. The forward quote can be given directly or in forward points (an adjustment from the spot quote).

Forward points are an adjustment to the spot price to determine the forward price. The points are interpreted based on the number of decimal places in which the spot price is quoted. The rule is to move the decimal in the points to the left by the same number of decimal places shown in the right for the spot price. For example:

Spot Quote	Forward Points	Points with Decimal Adjusted	Forward Price
1.33	1.1	1.1 / 100 = 0.011	1.33 + 0.011 = 1.341
2.554	–9.6	–9.6 / 1,000 = –0.0096	2.554 − 0.0096 = 2.5444
0.7654	13.67	13.67 / 10,000 = 0.001367	0.7654 + 0.001367 = 0.766767

There is a myth that the forward points are always divided by 10,000. That is only true if the spot quote is given to four decimal places. To continue the pattern, if the spot quote shows five decimals on the right, move the forward point decimal five places (/100,000) to the left.

EXAMPLE 1: Spot and forward bid/asked quotes of the Australian dollar/euro

Maturity/Settlement	Spot Quote/Forward Points
Spot AUD/EUR	1.2571/ 1.2574
30 days	–1.0/–0.9
90 days	+11.7/+12.0

1. What is the 30 day forward bid/offered quote?
2. If a manager sells 1,000,000 AUD forward 90 days, **calculate** what the manager will deliver and receive. When will the exchange take place?

Answer:

1. The spot quote is given to four decimal places making the forward points for 30 days: –1.0 / 10,000 = –0.00010 and –0.9 / 10,000 = –0.00009, a four decimal place adjustment to match the spot quote. The 30-day forward bid/asked are: 1.2571 − 0.00010 = 1.25700 and 1.2574 − 0.00009 = 1.25731.
2. The exchange will be 90 days from the trade date, at contract expiration. The manager will deliver AUD 1,000,000.

   The 90-day forward quotes are 1.2571 + 0.00117 by 1.2574 + 0.00120, which is 1.25827/1.25860 for the AUD/EUR. The manager is delivering AUD and receiving EUR. The manager must deliver more AUD or receive fewer EUR. In this case, the bid/asked quotes are both for 1 EUR and the manager will deliver AUD.

   The manager must deliver at AUD/EUR 1.25860.The manager will receive EUR: AUD 1,000,000 / (1.25860 AUD/EUR) = EUR 794,533.61.

盯市 **Offsetting Transactions and Mark to Market:** While forward contracts do not require market to market cash flow exchanges prior to settlement, it is often desirable or required for regulatory purposes to mark the position to market value. The mark-to-market value is the present value of any gain or loss that would be realized if the contract were closed early with an offsetting contract position.

EXAMPLE 2: Offsetting transactions

Based on the initial quotes given in the previous example, a different manager entered into a trade to sell (deliver) 90 days forward, EUR 10,000,000 at the “all-in” forward quote of AUD/EUR 1.25827. Thirty days have passed and exchange rates are now the following:

Maturity/Settlement	Spot Quote/Forward Points	LIBOR Rates AUD
Spot AUD/EUR	1.3189/1.3191	
30 days	+1.1/+1.2	1.10%
60 days	+10.3/+10.5	1.20%
90 days	+15.3/+16.1	1.25%

1. **Identify** the offsetting position the manager would take to close the initial transaction and **calculate** the resulting gain or loss. When will this gain or loss be settled?
2. **Calculate** the mark to market the manager would report on day 30 of the original trade if the trade were not closed out early.

Answers:

1. Thirty days have passed and the initial trade to sell EUR 10,000,000 forward has 60 days until expiration. The offsetting transaction is to buy 10,000,000 EUR 60 days forward. The solution is done in steps.

   Step 1: Thirty days have passed and the initial trade to sell EUR 10,000,000 forward has 60 days until expiration. The offsetting transaction is to buy 10,000,000 EUR 60 days forward. The solution is done in steps. Identify the forward exchange rate for the offsetting position. The manager must buy EUR 10,000,000 (which requires delivering AUD) 60 days forward at AUD/EUR 1.3191 + 0.00105, which is AUD/EUR 1.32015.

   Step 2: In 60 days, the manager will do the following:

- On the original trade: sell EUR 10,000,000 and buy AUD at AUD/EUR 1.25827. The manager will receive AUD 12,582,700.
- On the offsetting trade: buy EUR 10,000,000 and sell AUD at AUD/EUR 1.32015. The manager will pay AUD 13,201,500.

The difference, a loss of AUD 618,800, will be settled and paid 90 days after the initial transaction and 60 days after the offsetting transaction.

Alternatively, this can be solved directly. The base currency (euro) is sold at 1.25827 AUD and then bought at 1.32015 AUD for a loss of 1.32015 − 1.25827 = 0.06188 AUD per euro. On the trade of 10,000,000 euros, this is a loss of AUD 618,800.

2. The current mark to market is the present value of the gain or loss that would be locked in with an offsetting transaction. That offsetting loss was calculated in Solution 1 as AUD 618,800. The 60-day LIBOR rate on the AUD is 1.20%.

   Mark-to-market loss = AUD 618,800 / (1 + (0.012 (60 / 360))) = AUD 617,564.87

An FX Swap: The FX swap is not a currency swap or even a swap as that term is otherwise used. The FX swap rolls over a maturing forward contract using a spot transaction into a new forward contract. An existing forward is “swapped” for another forward transaction.

EXAMPLE 3: An FX swap

A manager purchased 10,000,000 South African rand (ZAR) three months forward at ZAR/USD 9.4518.

Two days before contract expiration the manager decides to extend the transaction for another 30 days. **Explain** the FX swap used to implement this decision.

Answer:

The manager sells spot ZAR 10,000,000 to offset the maturing contract. Both the initial forward and offsetting spot transaction will settle in two business days. The manager enters a new 30-day forward contract to buy ZAR 10,000,000 versus the USD to rollover the trade.

Option Basics: A call option is a right to buy the underlying and gains value as the underlying rises above the strike price; its delta approaches 1.00 (a 100-delta). The call loses value as the underlying falls below the strike price and its delta approaches 0.00 (a 0-delta).

A put is the right to sell the underlying and gains value as the underlying falls below the strike price; its delta approaches –1.00 (this can also be referred to as a 100-delta, the negative sign is assumed and not written). The put loses value as the underlying rises above the strike price and the delta approaches 0.00 (a 0-delta).

For a call and a put with identical parameters (time to expiration, strike price, and price of the underlying), the sum of the absolute deltas is 1.00 or 100-delta.

Currency Option Basics: Currency options require two currencies and a call on one currency is a put on the other currency. Unless otherwise specified, the option is from the base currency perspective. For example, a call option to buy 10,000,000 at a strike price of ZAR/GBP 14.56 is the right to buy 10,000,000 British pounds and sell 145,600,000 South African rand. It is also a put option—the right to sell 145,600,000 South African rand and buy 10,000,000 British pounds.

A put option to sell 100,000 at MXN/EUR at 20.1 is the right to sell 100,000 euros and buy 2,010,000 Mexican pesos. It is also a call option to buy 2,010,000 Mexican pesos and sell 100,000 euros.

The important relationships can be summarized as follows:

As the Price of the Base Currency Increases:	The Call Option to Buy the Base Currency:	The Put Option to Sell the Base Currency:
From 0 to the strike price	Is out-of-the-money and rising in value. Delta is shifting from 0.0 toward 0.5 (from a 0-delta to a 50-delta).	Is in-the-money and falling in value. Delta is shifting from –1.0 toward –0.5 (from a 100-delta to a 50-delta).
To the strike price	Is at-the-money. Delta is approximately 0.5 (a 50-delta).	Is at-the-money. Delta is approximately –0.5 (a 50-delta).
From the strike price upward	Is in-the-money and rising in value. Delta is shifting from 0.5 toward 1.0 (from a 50-delta to a 100-delta).	Is out-of-the-money and falling in value. Delta is shifting from –0.5 toward 0.0 (from a 50-delta to a 0-delta).

EFFECTS OF CURRENCY ON PORTFOLIO RISK AND RETURN

Domestic currency or **home currency** is the currency of the investor (or the currency in which portfolio results are reported and analyzed).

Domestic asset is an asset denominated in the investor's domestic currency.

Foreign currency and **foreign asset** are a currency other that the investor's domestic currency and an asset denominated in that foreign currency. These are sometimes called the local currency and local market, respectively.

Foreign-currency return (R_{FC}) is the return of the foreign asset measured in its local (foreign) currency. It can be called the local market return.

The **percentage change in value of the foreign currency** is denoted as R_{FX}. It can be called the local currency return.

Domestic-currency return(R_{DC}) is the return in domestic currency units considering both the **foreign-currency return** (R_{FC}) and the percentage change in value of the foreign currency (R_{FX}).

LOS 21.a: Analyze the effects of currency movements on portfolio risk and return.

CFA® Program Curriculum, Volume 3, page 391

An investment in assets priced in a currency other than the investor's domestic currency (a *foreign asset* priced in a *foreign currency*) has two sources of risk and return: (1) the return on the assets in the foreign currency and (2) the return on the foreign currency from any change in its exchange rate with the investor's *domestic currency*. These returns are multiplicative and an investor's returns in domestic currency can be calculated as: 乘法

Equation 1: $R_{DC} = (1 + R_{FC})(1 + R_{FX}) - 1 = R_{FC} + R_{FX} + (R_{FC})(R_{FX})$

$R_{DC} \approx R_{FC} + R_{FX}$

PROFESSOR'S NOTE

There are three ways to calculate R_{DC} that you will see and are responsible for. The choice of approach is dictated by the case facts and question.

- $R_{DC} \approx R_{FC} + R_{FX}$: This approach is an approximation of the more accurate compounded calculation. It emphasizes the two sources of return, R_{FC} and R_{FX}. It is acceptable when precision is not needed, such as selecting between three quite different multiple choice answers or discussing the theoretical sources of return.
- $R_{DC} = (1 + R_{FC})(1 + R_{FX}) – 1 = R_{FC} + R_{FX} + (R_{FC})(R_{FX})$: This approach is precise if the precise R_{FX} is known. I would generally use this approach, unless given clear reasons to do something else.
- However, there are cases where determining R_{FX} is not simple. If the currency is hedged, then a precise currency hedge must short the ending number of foreign currency units; however, that ending number is not knowable for a risky asset. You will see a naïve hedge is normally used and the beginning number of foreign currency units are sold forward. In that case, a simple comparison of Fo and So will not be the true R_{FX}. In that case, you will see a different set of calculations made. You would directly calculate beginning and ending value of the portfolio in the investor's domestic currency units. Then R_{DC} is (EV – BV) / BV.

EXAMPLE 4: Calculating domestic currency returns

Consider a USD-based investor who invests in a portfolio of stocks that trade in euros. Over a one-year holding period, the value of the portfolio increases by 5% (in euros) and the euro-dollar exchange rate increases from 1.300 USD/EUR to 1.339 USD/EUR.

The EUR has appreciated with respect to the USD, so the investor has positive returns from foreign exchange of:

$R_{FX} = 1.339 / 1.300 - 1 = 0.03 = 3\%.$

The investor's return in domestic currency terms over the one-year holding period is:

$R_{DC} = (1.05 \times 1.03) - 1 = 0.05 + 0.03 + (0.05)(0.03) = 0.0815 = 8.15\%$

$R_{DC} \approx R_{FC} + R_{FX} = 5 + 3 = 8\%$

This example illustrates two important points. First, simply adding R_{FC} and R_{FX} (5% + 3% = 8%) yields an approximation of the domestic currency return. The approximation is closer to the actual return the smaller the values of the two sources of return.

Second, the exchange rate quotes must use the foreign currency (EUR) as the base currency (the denominator) to calculate the change in value of the currency (R_{FX}). To see why, consider what happens if the domestic currency (USD) had been the base currency.

FX Quotes	Foreign Currency as the Base Currency	1/X for Domestic Currency as the Base Currency
Beginning value	USD/EUR 1.300	EUR/USD 0.76923
Ending value	USD/EUR 1.339	EUR/USD 0.74683

0.74683/0.76923 − 1 = –0.02912 = –2.912%, which is depreciation of the USD relative to the EUR. The appreciation of the EUR is not simply the negative of the depreciation in the USD. R_{FX} is 3.000%, not 2.912%.

PROFESSOR'S NOTE

The message is to be careful when working with currency. Read the question and determine which is the foreign versus domestic currency. Label the numbers to determine if you are looking at domestic/foreign or foreign/domestic. Always use domestic/foreign (taking reciprocals if needed) and then solve as $EV / BV - 1 = R_{FX}$.

CALCULATING PORTFOLIO RETURN FOR MULTIPLE INVESTMENTS IN FOREIGN ASSETS

An investor may invest in multiple markets with different currencies. In that case, the domestic portfolio return is a weighted average of the domestic currency returns for each investment. Formally, we have the following.

$$\text{Equation 2: } R_{DC} = \sum_{i=1}^{n} w_i \left(R_{DC,i}\right)$$

where:

w_i = the proportion (in domestic currency terms) of the portfolio invested in assets traded in currency *i*

$R_{DC,i}$ = the domestic currency return for asset *i*

The following example illustrates this calculation.

EXAMPLE 5: Domestic currency returns on an investment in two foreign markets.

A euro-based investor has a 75% position in GBP denominated assets and a 25% position in USD denominated assets. The results for the past year are the following.

R_{FC} for the GBP assets = 12%

R_{FC} for the USD assets = 5%

Beginning EUR/GBP exchange rate: 1.1666

Ending EUR/GBP exchange rate: 1.1437

Beginning USD/EUR exchange rate: 1.332

Ending USD/EUR exchange rate: 1.324

Calculate the investor's return over the period in domestic (EUR) currency terms.

Answer:

First, calculate the R_{DC} (in EUR) for each investment.

For the investment denominated in GBP, we have:

R_{DC} = 1.12 × (1.1437 / 1.1666) − 1 = (1.1200 × 0.9804) − 1 = 9.80%.

The foreign currency (GBP) has depreciated approximately 2% relative to the euro. The negative currency return reduces the 12% return of the foreign market.

For the investment denominated in USD, the exchange rates were given with the foreign currency (USD) in the numerator. These can be inverted to make the investor's currency (the euro) the price currency and the foreign currency (USD) the base currency.

1/1.332 = 0.7508 EUR/USD

1/1.324 = 0.7553 EUR /USD

Allowing the investment denominated in USD R_{DC} (in EUR) to be calculated as:

$R_{DC} = [1.05 \times (0.7553 / 0.7508)] - 1 = (1.0500 \times 1.0060) - 1 = 5.63\%$

The foreign currency (USD) has appreciated approximately 0.6% relative to the euro. The positive currency return increases the 5% return of the foreign market.

The investor's total portfolio return is the weighted average of the R_{DC} for each market:

$(0.75 \times 9.80\%) + (0.25 \times 5.63\%) = 7.35 + 1.41 = 8.76\%$

RISK

An investor investing in a foreign denominated asset has two sources of risk: the fluctuation of the foreign currency and the fluctuation in foreign currency price of the foreign asset. Both will affect the standard deviation of R_{DC}.

The variance of R_{DC} can be calculated using a variation of the basic formula for variance of a two asset portfolio:

$$\sigma^2(R_{DC}) \approx w^2(R_{FC})\sigma^2(R_{FC}) + w^2(R_{FX})\sigma^2(R_{FX})$$
$$+ 2w(R_{FC})w(R_{FX})\sigma(R_{FC})\sigma(R_{FX})\rho(R_{FC},R_{FX})$$

where:

ρ = the correlation between R_{FC} and R_{FX}

However, this basic two asset variance formula can be simplified when a domestic investor holds a single foreign currency denominated asset. The exposures (weights) to R_{FC} and R_{FX} are each 100% with the weights in the formula expressed as 1.0. The formula becomes:

Equation 3: $\sigma^2(R_{DC}) \approx \sigma^2(R_{FC}) + \sigma^2(R_{FX}) + 2\sigma(R_{FC})\sigma(R_{FX})\rho(R_{FC},R_{FX})$

The standard deviation of R_{DC} is the square root of this variance. Examining the equation indicates risk to our domestic investor:

- Depends on the standard deviation of R_{FC} and R_{FX}.
- May be higher for our domestic investor because standard deviation of R_{FX} is an additive term in the equation.
- However, correlation also matters. If the correlation between R_{FC} and R_{FX} is negative, the third component of the calculation becomes negative. The correlation measures the interaction of R_{FC} and R_{FX}.

- If the correlation is positive, then R_{FC} returns are amplified by R_{FX} returns, increasing the volatility of return to our domestic investor.
- If the correlation is negative, then R_{FC} returns are dampened 抑制 by R_{FX} returns, decreasing the volatility of return to our domestic investor. (This is discussed further under this reading's topic of minimum variance hedge ratio).

PROFESSOR'S NOTE

The variance formula in Equation 3 is only an approximation but appropriate. It is based on the simple addition of R_{FC} and R_{FX} and ignores the cross product of $(R_{FC})(R_{FX})$. The use of an approximate variance formula relates to the number of correlations that would be required for true variance. Consider a portfolio of two foreign assets that has four variables, two foreign assets, and two foreign currencies resulting in six correlation pairs. With three foreign assets, there are six variables resulting in a total of 15 correlation pairs. A precise variance calculation would require accurately estimating all possible correlation pairs. That is considered unrealistic and the exact formula would create a false impression of precision. The approximation method is used for the CFA text. A special case is discussed below. Think of this special case as risk depends on end of period exposure to the foreign asset.

If R_{FC} is a Risk-Free Return: In this case, its standard deviation and correlation with R_{FX} are zero. When R_{FX} is the only source of risk for the domestic investor in the foreign asset, a direct and precise calculation of the standard deviation of R_{DC} is practical.

Equation 4: $\sigma(R_{DC}) = \sigma(R_{FX})(1 + R_{FC})$

where:

R_{FC} = the return on a foreign currency denominated risk-free asset

STRATEGIC DECISIONS

LOS 21.b: Discuss strategic choices in currency management.

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PROFESSOR'S NOTE

This is a lengthy discussion of factors to consider. The next LOS summarizes the conclusions.

Neither academic nor empirical analysis support firm conclusions on currency risk management. Opinions range from doing nothing to active management.

- Arguments made for not hedging currency risk include:
  - It is best to avoid the time and cost of hedging or trading currencies.
  - In the long-run, unhedged currency effects are a "zero-sum game"; if one currency appreciates, another must depreciate.
  - In the long-run, currencies revert to a theoretical fair value.

- The argument for active management of currency risk is that, in the short run, currency movement can be extreme, and inefficient pricing of currencies can be exploited to add to portfolio return. Many foreign exchange (FX) trades are dictated by international trade transactions or central bank policies. These are not motivated by consideration of fair value and may drive currency prices away from their fair value.

Currency management strategies for portfolios with exchange rate risk range from a passive approach of matching benchmark currency exposures to an active strategy that treats currency exposure independently of benchmark exposures and seeks to profit from (rather than hedge the risk of) currency exposures. Different approaches along this spectrum include:

Passive hedging is rule based and typically matches the portfolio's currency exposure to that of the benchmark used to evaluate the portfolio's performance. It will require periodic rebalancing to maintain the match. The goal is to eliminate currency risk relative to the benchmark.

Discretionary hedging allows the manager to deviate modestly from passive hedging by a specified percentage. An example is allowing 5% deviations from the hedge ratio that would match a currency's exposure to the benchmark exposure. The goal is to reduce currency risk while allowing the manager to pursue modest incremental currency returns relative to the benchmark.

Active currency management allows a manager to have greater deviations from benchmark currency exposures. This differs from discretionary hedging in the amount of discretion permitted and the manager is expected to generate positive incremental portfolio return from managing a portfolio's currency exposure. The goal is to create incremental return (alpha), not to reduce risk.

A **currency overlay** is a broad term covering the outsourcing of currency management. At the extreme, the overlay manager will treat currency as an asset class and may take positions independent of other portfolio assets. Seeking incremental return, an overlay manager who is bearish on the Swedish krona (SEK) for a portfolio with no exposure to the SEK would short the SEK. The manager is purely seeking currency alpha (incremental return), not risk reduction.

Overlay managers can also be given a pure risk reduction mandate or restricted to risk reduction with modest return enhancement.

The IPS: The account's policy on whether to hedge or not to hedge currency risk should be recorded in the client's investment policy statement (IPS). Sections of the IPS that will be particularly relevant in reaching this strategic decision include investor objectives (including risk tolerance), time horizon, liquidity needs, and the benchmark to be used for analyzing portfolio results. The IPS should also specify:

- The target percentage of currency exposure that is to be hedged.
- Allowable discretion for the manager to vary around this target.
- Frequency of rebalancing the hedge.
- Benchmarks to use for evaluating the results of currency decisions.
- Allowable (or prohibited) hedging tools.

EXAMPLE 6: Choosing a hedging approach

A client with a USD based portfolio has little need for liquidity and is focused on short- term performance results. The client evaluates performance relative to a global equity index, which fully hedges currency exposure back to the USD and rebalances the hedge monthly.

1. **Discuss** how this information would affect the manager's views on hedging currency exposure in the portfolio.
2. **Explain** why rebalancing of currency exposure could be needed even if no changes are made to asset holdings.

Answers:

1. The client information leads to two possible strategies. (A) If the manager lacks currency expertise, the manager should also fully hedge currency risk and rebalance monthly, then focus on other areas such as asset selection to add value. (B) If the manager does have views on currency movement, the manager can instead increase exposure to currencies expected to appreciate and decrease exposure to currencies expected to depreciate.

   Given the client's focus on short-term results, the manager must consider the currency exposure of the index and either match it or deliberately deviate. A long-term assumption that "currency does not matter" is not appropriate. The lack of liquidity needs reduces the need for currency hedging as it reduces the likelihood of liquidations of foreign asset positions at depressed values.
2. Suppose both the U.S. client and the index allocate 10% to U.K. equities and sell the GBP forward to fully hedge the currency risk. Then over the course of the month, the U.K. stocks in the benchmark fall in value ($–R_{FC}$) while the U.K. stocks in the portfolio rise in value ($+R_{FC}$). The index will reduce the short GBP position to reflect the decreased GBP asset value. In contrast, the manager needs to increase the GBP short position to reflect increased GBP market value. Rebalancing the hedge must consider not only explicit transactions by the manager but also differentials in R_{FC} between the index and the portfolio.

Strategic Diversification Issues

- In the longer run, currency volatility has been lower than in the shorter run, reducing the need to hedge currency in portfolios with a long-term perspective.
- Positive correlation between returns of the asset measured in the foreign currency (R_{FC}) and returns from the foreign currency (R_{FX}) increase volatility of return to the investor (R_{DC}) and increase the need for currency hedging. Negative correlation dampens return volatility and decreases the need to hedge.
- Correlation tends to vary by time period, providing diversification in some periods and not in others, suggesting a varying hedge ratio is appropriate.
- Some investors assert that there is higher positive correlation between asset and currency returns in bond portfolios than in equity portfolios. If that is true, then there is more reason to hedge currency risk in bond portfolios than in equity portfolios. In a bond portfolio, the riskiness of the asset and currency are more likely to reinforce each other.
- The hedge ratio (the percentage of currency exposure to hedge) varies by manager preference.

Strategic Cost Issues: Hedging is not free and benefits must be weighted versus costs.

- The bid/asked transaction cost on a single currency trade is generally small, but repeated transaction costs add up. Full hedging and frequent rebalancing can be costly.

- Purchasing options to hedge involves an upfront option premium cost. If the option expires out-of-the-money, the premium is lost.
- Forward currency contracts are often shorter term than the hedging period, requiring contracts be rolled over as they mature (an FX swap). The hedge lowers return volatility but the rollover can create cash flow volatility with realized gains and losses on the maturing contracts. Financing cash outflows when interest rates are high can be costly as the interest that would have been earned on the funds is lost.
- Overhead costs can be high. A back office and trading infrastructure are needed for currency hedging. Cash accounts in multiple currencies may have to be maintained to support settlements and margin requirements.
- One hundred percent hedging has an opportunity cost with no possibility of favorable currency movement. Some managers elect to "split the difference" between 0 and 100% hedging and adopt a 50% strategic hedge ratio.
- Hedging every currency movement is costly and managers generally chose partial hedges. They may hedge and rebalance monthly rather than daily or accept some amount of negative currency return rather than zero.

LOS 21.c: Formulate an appropriate currency management program given financial market conditions and portfolio objectives and constraints.

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In conclusion, the factors that shift the strategic decision formulation toward a benchmark neutral or fully hedged strategy are:

- A short time horizon for portfolio objectives.
- High risk aversion.
- A client who is unconcerned with the opportunity costs of missing positive currency returns.
- High short-term income and liquidity needs.
- Significant foreign currency bond exposure.
- Low hedging costs.
- Clients who doubt the benefits of discretionary management.

MODULE QUIZ 21.1

To best evaluate your performance, enter your quiz answers online.

Use the following information for Questions 1 and 2.

A Djiboutian (DJF) investor holds an international portfolio with beginning investments of USD 1,253,000 and EUR 2,347,800. Measured in the foreign currencies, these investments appreciate 5% and depreciate 7%, respectively.

Additional information:

Beginning Spot Exchange Rate	Beginning Forward Exchange Rate	Ending Spot Exchange Rate
DJF/USD 179.54	DJF/USD 185.67	DJF/USD 192.85
EUR/DJF 0.00416	EUR/DJF 0.00413	EUR/DJF 0.00421

1. The ending value of the USD investment is *closest* to:
   A. USD 1,150,000.
   B. DJF 236,200,000.
   C. DJF 253,700,000.
2. The unhedged return to the investor of the U.S. investment is *closest* to:
   A. –3%.
   B. +3%.
   C. +12%.
3. A European investor holds a diversified portfolio. From the euro perspective, the portfolio is weighted 60% and 40% in U.S. and U.K. investments.

Assets	Returns measured in foreign currency	Returns measured from investor's perspective	Standard deviation of asset's returns measured in foreign currency	Standard deviation of the foreign currency's returns
U.S.	5%	6%	4.5%	3.7%
U.K.	7%	8%	3.5%	4.7%

The correlation between the foreign-currency asset's returns and returns on the foreign currency are 0.81 and 0.67, respectively, for the U.S. and English assets. **Compute** the standard deviation for the investor in the U.S. assets. **Show** your work.

Variance = (1.0^2)(4.5^2) + (1.0^2)(3.7^2) + 2(1.0)(1.0)(0.81)(4.5)(3.7) = 60.913, Sigma=7.8%

4. The strategic decision to hedge currency risk will be *least* affected by the:
   A. manager's market views.
   B. correlation between asset and currency returns.
   C. investor's time horizon, risk aversion, and liquidity needs.
5. Which of the following clients would *most likely* allow a manager to implement discretionary currency hedging?
   A. One with a shorter time horizon and higher liquidity needs.
   B. One with more confidence in the portfolio manager and high income needs.
   C. One very concerned with minimizing regret and higher allocation to equity investments.
6. Jane Simms manages a German portfolio and has a 1,000,000 long position in South Korean won (KRW) through a forward contract that is about to come due. The current spot exchange rate is EUR/KRW 0.00067/0.00068. The forward points for a three-month forward contract are –1.2/–1.1. She expects the KRW to depreciate significantly and has the authority to increase or decrease the contract size by 10%. **Explain** whether she will increase or decrease the size of the forward contract and the forward exchange rate at which she will contract.

7. Jane Archer manages a Swiss-based (CHF) hedge fund. A portion of the fund is allocated 60% and 40%, respectively, to EUR and AUD investments. She has collected the following information.

Estimates	Euro zone	Australia
Asset return in foreign currency	2.0%	2.5%
Change in spot exchange rate versus the CHF	–1.0%	3.0%
Asset risk measured in foreign currency (σ)	15.0%	25.0%
Currency risk (σ)	7.0%	9.0%
Correlation of asset and currency return	+0.85	+0.65
Correlation of returns (CHF/EUR, CHF/AUD)	+0.70	

The following questions are from the portfolio perspective, measured in CHF.

a. **Calculate** the expected return of the portfolio.

b. **Calculate** the standard deviation of the portfolio.

c. **Calculate** the expected return to the portfolio if Archer takes a leveraged position with a 150% positive weight in Australia and a 150% negative weight in the euro zone.

d. **Calculate** the expected standard deviation of returns to the portfolio if Archer takes a leveraged position with a 150% positive weight in Australia and a 150% negative weight in the euro zone.

MODULE 21.2: ACTIVE STRATEGIES: FUNDAMENTALS AND TECHNICAL

LOS 21.d: Compare active currency trading strategies based on economic fundamentals, technical analysis, carry-trade, and volatility trading.

Video covering this content is available online.

CFA® Program Curriculum, Volume 3, page 406

The strategic decision sets the portfolio's normal currency hedging policy. If discretion is allowed, the manager can make active tactical decisions within defined boundaries, seeking to increase return. In all cases, active management requires that the manager have a view or a prediction of what will happen. Tactical decisions can be based on four broad approaches. Unfortunately, none of the approaches works consistently.

Economic Fundamentals

This approach assumes that, in the long term, currency value will converge to fair value. For example, a fundamental approach may assume purchasing power parity will determine long-run exchange rates. If the basket of goods and services produced in Country A costs 100 units of Country A's currency and that basket costs 200 units of Country B's currency in Country B, then the currency exchange rate of A to B is 100/200, a 0.50 A/B exchange rate.

Several factors will impact the eventual path of convergence over the short and intermediate terms. Increases in the value of a currency are associated with currencies:

- That are more undervalued relative to their fundamental value.
- That have the greatest rate of increase in their fundamental value.
- With higher real or nominal interest rates.
- With lower inflation relative to other countries.
- Of countries with decreasing risk premiums.

Opposite conditions are believed to be associated with declining currency values.

Technical Analysis

Technical analysis of currency is based on three principals:

1. Past price data can predict future price movement and because those prices reflect fundamental and other relevant information, there is no need to analyze such information.
2. Fallible human beings react to similar events in similar ways and therefore past price patterns tend to repeat.
3. It is unnecessary to know what the currency should be worth (based on fundamental value); it is only necessary to know where it will trade.

Technical analysis looks at past price and volume trading data. FX technical analysis focuses on price trends as volume data is generally less available. Technical analysis works best in markets with identifiable trends. Typical patterns that technicians seek to exploit are the following.

超买
- An **overbought** (or **oversold**) market has gone up (or down) too far and the price is likely to reverse.

支撑位
- A **support level** exists where there are substantial bids from customers to buy. A price that falls to that level is then likely to reverse and bounce higher as the purchases are executed.

压力位
- A **resistance level** exists where there are substantial offers from customers to sell. A price that rises to that level is then likely to reverse and bounce lower as the sales are executed.

At both support and resistance levels, the price becomes "sticky." However, if the market moves through the sticky resistance levels, it can then accelerate and continue in the same direction.

For example, assume technical traders have observed a support level for the GBP at 1.70 USD/GBP. The traders place limit orders to buy GBP at 1.70 USD/GBP. However, to limit their losses, the traders also enter stop loss orders to sell GBP at various prices between 1.70 and 1.69. If the GBP declines to the support level of 1.70, the buy orders are executed, supporting that price and explain the "sticky price behavior." However, if the GBP then declines lower, the stop loss sell orders are executed, driving the GBP lower as the GBP breaks its support level.

Moving averages of price are often used in technical analysis. A common rule is that if a shorter-term moving average crosses a longer-term moving average, it triggers a signal. The 50-day moving average rising above the 200-day moving average is a buy signal, falling below is a sell signal.

MODULE 21.3: ACTIVE STRATEGIES: CARRY AND VOLATILITY TRADING

The Carry Trade

Video covering this content is available online.

A **carry trade** refers to borrowing in a lower interest rate currency and investing the proceeds in a higher interest rate currency. Three issues are important to understand the carry trade.

1. **Covered interest rate parity** (CIRP) holds by arbitrage and establishes that the difference between spot (S_0) and forward (F_0) exchange rates equals the difference in the periodic interest rates of the two currencies.
   - The currency with the higher interest rate will trade at a **forward discount**, $F_0 < S_0$
   - The currency with the lower interest rate will trade at a **forward premium**, $F_0 > S_0$
2. The carry trade is based on a violation of **uncovered interest rate parity** (UCIRP). UCIRP is an international parity relationship asserting that the forward

exchange rate calculated by CIRP is an unbiased estimate of the spot exchange rate that will exist in the future. If this were true:

- The currency with the higher interest rate will decrease in value by the amount of the initial interest rate differential.
- The currency with the lower interest rate will increase in value by the amount of the initial interest rate differential.

If these expectations were true, a carry trade would earn a zero return.

3. Because the carry trade exploits a violation of interest rate parity, it can be referred to as trading the forward rate bias. Historical evidence indicates that:

大多数时间高利率货币贬的少

- Generally, the higher interest rate currency has depreciated less than predicted by interest rate parity or even appreciated and a carry trade has earned a profit.

少数时间贬的多

- However, a small percentage of the time, the higher interest rate currency has depreciate substantially more than predicted by interest rate parity and a carry trade has generated large losses.

Generally, the carry trade is implemented by borrowing in the lower interest rate currencies of developed economies (**funding currencies**) and investing in the higher interest rate currencies of emerging economies (**investing currencies**). In periods of financial stress, the currencies of the higher risk emerging economies have depreciated sharply relative to the currencies of developed economies and such carry trades have generated significant losses. Given that periods of financial stress are associated with increasing exchange rate volatility, traders often exit their carry trade positions when exchange rate volatility increases significantly.

EXAMPLE 7: A carry trade

The spot exchange rate is BRL/USD 2.41. The interest rates in the two countries are 6% and 1%, respectively.

1. **Estimate** the one-year forward exchange rate for the Brazilian Real.
2. **State** the steps to initiate the carry trade and the theory on which it is based.
3. What is the profit on the trade if the spot exchange rate is unchanged and the trade is initiated by borrowing 100 currency units? **Show** your work.
4. What is the primary risk in this trade?

Answers:

1. The forward exchange rate for the Real should be approximately 5% below the current spot exchange rate to reflect the initial interest rate differential. The precise calculation is:

   BRL/USD 2.41 × (1.06 / 1.01)1 = BRL/USD 2.529

2.
   - Borrow USD at 1%.
   - Convert USD to BRL at the spot exchange rate of BRL/USD 2.41.
   - Invest the BRL at 6%.

   The carry trade is based on a violation of uncovered interest rate parity. It is profitable if the spot exchange rate of the higher interest rate currency declines less than predicted by the forward exchange rate.

3. It is 5%, reflecting the initial interest rate difference and unchanged spot exchange rate.
    - Borrow USD 100 creating a loan payable of USD 101.
    - Convert USD 100 to BRL 241 (= 100 × 2.41).
    - Invest the BRL 241 at 6% creating an ending value of BRL 255.46.
    - Convert the BRL 255.46 at the unchanged spot exchange rate back to USD 106.00 (= 255.46 / 2.41).
    - Pay off the USD loan for a profit of USD 5.00 on a USD 100 initial investment.
4. This is an unhedged trade and the profit or loss depends on the ending value of the BRL. If the BRL declines by more than 5%, the trade is unprofitable.

Figure 21.1: Summary of the Carry Trade

The Carry Trade:		
Is implemented by:	Borrowing and then selling in the spot market the lower yield currency.	To buy and invest in the higher yield currency.
Is trading the forward rate bias:	Selling in the spot market the currency trading at a forward premium.	And buying in the spot market the currency trading at a forward discount.

The carry trade is generally profitable under normal market conditions. But it can generate large losses in periods of financial distress and high volatility as investors flee high risk (yield) currencies.

PROFESSOR'S NOTE

You should notice this section does not support using the forward exchange rate as a prediction of how currency value will change, sometimes referred to as uncovered interest rate parity (UCIRP). Under IRP, the currency with the higher short-term interest rate will trade at a forward discount. UCIRP asserts that this calculated forward rate is a prediction of what will happen to the spot exchange rate and the higher rate currency will depreciate. This section has (1) noted that empirical evidence indicates the currency with the higher rate tends to appreciate, not depreciate, and (2) the carry trade is based on the higher rate currency appreciating or depreciating less than suggested by UCIRP. You should conclude that the Level III curriculum does not support using the forward exchange rate as a valid prediction of what will happen. The forward exchange rate can be and is used for hedging, but it just is not a good predictor of how the spot exchange rate will move, unless you want a very short career as a currency manager.

Volatility Trading

Volatility or "vol" trading allows a manager to profit from predicting changes in currency volatility. Recall from Level I and Level II that **delta** measures the change in value of an option's price for a change in value of the underlying and that **vega** measures change in value of the option for changes in volatility of the underlying. Vega is positive for both puts and calls because an increase in the expected volatility of the price of the underlying increases the value of both puts and calls.

Delta hedging entails creation of a **delta-neutral position**, which has a delta of zero. The delta-neutral position will not gain or lose value with small changes in the price of the underlying assets, but it will gain or lose value as the implied volatility reflected in the price of options changes. A manager can profit by correctly predicting changes in volatility.

A manager expecting volatility to increase should enter a **long straddle** by purchasing an at-the-money call and put. The manager is buying volatility. The two options will have equal but opposite deltas making the position delta neutral. If volatility increases, the options will rise in net value and the trade will be profitable.

A manager expecting volatility to decrease should enter a **short straddle** by selling both of these options. If volatility declines, the options will fall in net value. The options can be repurchased at lower prices for a profit.

PROFESSOR'S NOTE

Delta hedging will come up several times in the CFA curriculum. An important caveat is that the deltas will change and the positions must be continually rebalanced to maintain a delta-neutral position.

A **strangle** will provide similar but more moderate payoffs to a straddle. Out of-the-money calls and puts with the same absolute delta are purchased. The out-of-the-money options require larger movement in the currency value to create intrinsic value but will cost less. Both the initial cost and the likely profit are lower than for the straddle.

MODULE QUIZ 21.2, 21.3

To best evaluate your performance, enter your quiz answers online.

1. A currency overlay manager will *most likely* implement a carry trade when the yield of investing currencies is:
    A. lower and volatility is falling.
    B. higher and currency volatility is rising.
    C. higher and currency volatility is stable.
2. Which of the following statements about volatility and interest rates is *most likely* true?
    A. Falling currency volatility leads traders to exit a carry trade.
    B. Rising currency volatility will increase the cost of a collar more than the cost of a protective put.
    C. A delta neutral hedging strategy is more likely to tilt to a net long position in the euro when the euro zone is experiencing rising real interest rates.

MODULE 21.4: IMPLEMENTATION AND FORWARDS

LOS 21.e: Describe how changes in factors underlying active trading strategies affect tactical trading decisions.

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Video covering this content is available online.

Active trading strategies are, by definition, risky. An active manager forms market expectations and implements shorter term tactical strategies seeking to add value. If the manager is wrong or does not cover the transaction costs, return is reduced. Manager expectations that trigger tactical trading decisions include the following.

Expectation:		Action:
Relative currency:	Appreciation	Reduce the hedge (short position) on **OR** increase the long position in the currency
	Depreciation	Increase the hedge on or decrease the long position in the currency
Volatility:	Rising	Long straddle (or strangle)
	Falling	Short straddle (or strangle)
Market conditions:	Stable	A carry trade
	Crisis	Discontinue the carry trade

Subtle variations on these actions include the following.

- A carry trade may involve a bundle of funding and investment currencies and positions need not be equally weighted. For example, if the manager expects a particular currency to show greater relative increase in value, the trade would be structured with increased long (or decrease short) positions in that currency.
- Delta neutral positions can be "tilted" to net positive or negative based on the manager's view. A manager expecting a currency to appreciate (depreciate) could shift to a net positive (negative) delta.

CURRENCY MANAGEMENT TOOLS

PROFESSOR'S NOTE

We now examine a variety of hedging techniques and tools plus special considerations that may arise in some situations. The CFA text includes the warning "rote memorization" is not advised. Instead think of basic "building blocks" that allow an infinite number of combinations; focus on the basic concepts and terminology.

Some useful tips to sort through the material include the following. Some of these may be repeated from other sections.

1. What is the currency exposure that needs to be hedged? A typical situation is a portfolio exposed to fluctuation in value of a foreign currency.
2. It is easier to work with FX quotes when the foreign currency is the base currency. If quotes are given as B/P, take the reciprocal to make it P/B.
3. Assume any statements or directions refer to the base currency unless otherwise indicated in the case. But be explicit in your answers and state the currency you are referring to.
4. Decide whether the case requires buying or selling the base currency.
   - Buying forwards (and futures) or buying call options on the base currency increases exposure to the base currency.
   - Selling forwards (and futures) or buying put options on the base currency decreases exposure to the base currency.

- Remember that:
  - A call on the base currency is a put on the pricing currency.
  - A put on the base currency is a call on the pricing currency.

5. Hedging is not free.
   - Hedges using forwards have no or minimal initial cost but high opportunity cost because the potential upside of the hedged currency is eliminated.
   - Purchasing options has high initial cost but retains the upside of the hedged currency (the protective put strategy).
   - Lowering the cost of the hedge will require some combination of less downside protection or upside potential. Cost can be lowered through some combination of:
     - Writing options to generate premium inflow.
     - Adjusting the option strike prices.
     - Adjusting the size (notional amount) of the options.
     - Adding exotic features to the options.
6. Discretionary hedging allows the manager to deviate from a policy neutral hedge position. Allowing the manager discretion can lower hedging costs and enhance return but also increases the risk of underperformance.
7. The IPS (or question specifics) should define the strategic, policy neutral hedge position. Generally this is a 100% hedge to match the currency exposure of the portfolio's benchmark.

LOS 21.f: Describe how forward contracts and FX (foreign exchange) swaps are used to adjust hedge ratios.

CFA® Program Curriculum, Volume 3, page 419

Typically, **forward contracts** are preferred for currency hedging because:

- They can be customized, while futures contracts are standardized.
- They are available for almost any currency pair, while futures trade in size for only a limited number of currencies.
- Futures contracts require margin which adds operational complexity and can require periodic cash flows.
- Trading volume of FX forwards and swaps dwarfs that of FX futures, providing better liquidity.

A hedge can be a **static hedge**, which is established and held until expiration, or a **dynamic hedge**, which is periodically rebalanced.

Consider a EUR-based manager who must hedge an initial CHF 10,000,000 of asset exposure. One month later, the asset has appreciated to CHF 11,000,000. Assume the manager can initially sell a one- or three-month contract.

1. Initially sell 10,000,000 CHF in the forward market with a one-month forward contract. At contract expiration, roll over the hedge. At rollover, the change in initial contract price will produce a realized gain or loss and cash flow settlement

consequences. At the rollover, the size of the new contract can be adjusted to match the new value of the position to be hedged. Over the initial month, the hedge is static but can be dynamic at the rollover.

If desired, the rollover can be done using an FX swap so that cash flows occur on the expiration date of the initial contract. For an FX swap, the manager would, two days prior to initial contract expiration, buy CHF 10 million in the spot market to cover the short position in the forward and sell forward CHF 11 million to roll over the hedge. This is termed a "mismatched" FX swap because the "near" spot leg and "far" forward leg are not of equal size.

Both the initial short forward contract and the spot market purchase of CHF are for CHF 10,000,000 and settle in two business days. Any difference between the EUR/CHF rate of the initial forward contract and the current spot price will produce a (positive or negative) cash flow in EUR. For example, if the CHF declined by EUR 0.01, the initial hedge (short forward) will produce a cash gain of EUR 100,000 (= EUR 0.01 × 10,000,000).

2. Initially sell 10,000,000 CHF in the forward market with a three-month forward contract. One month later, the manager is underhedged with a CHF 10,000,000 short position versus an asset now worth CHF 11,000,000.
    a. With a static hedge, the manager would do nothing even though CHF exposure has increased.
    b. With a dynamic hedge, the manager would increase the hedge to cover the additional exposure by selling an additional CHF 1 million forward for two months to create a total short position of CHF 11 million. Because no contracts are being closed on the rebalancing date, all realized gain and losses and cash flows are deferred until the end of the three-month period. A dynamic hedging strategy will specify periodicity of rebalancing the hedge.

The choice of hedging approach should consider:

- Shorter term contracts or dynamic hedges with more frequent rebalancing tend to increase transaction costs but improve the hedge results.
- Higher risk aversion suggests more frequent rebalancing.
- Lower risk aversion and strong manager views suggest allowing the manager greater discretion around the strategic hedging policy.

ROLL YIELD

Hedging also exposes the portfolio to **roll yield** or **roll return**. Roll yield is a return from the movement of the forward price over time toward the spot price of an asset. It can be thought of as the profit or loss on a forward or futures contract if the spot price is unchanged at contract expiration. Determining whether the roll yield produces a profit or a loss will depend on two factors: (1) whether the currency is trading at a forward premium or discount and (2) whether is it purchased or sold. Roll yield for a contract held to expiration is determined by initial forward minus spot price divided by initial spot price.

For example, consider an investor who sells CHF 1 million six-month forward for USD 1.05 when the spot rate is 1.04. The forward price is at a premium so the roll yield on a short position will be positive. Think of it as the investor sells at a high price and the price rolls down for a gain. The investor can deliver CHF 1 million for 1.05 USD when its initial cost in the market (at spot) is 1.04 USD, for a gain of USD 10,000. The unannualized roll yield is 0.01/1.04 = 0.96%.

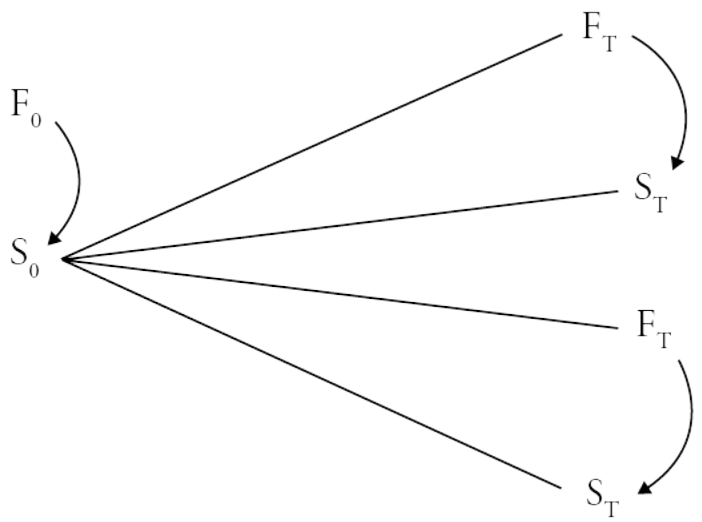
Roll yield will affect the cost/benefit analysis of whether to hedge the currency risk. It is a cost of hedging. Positive roll yield will shift the analysis toward hedging and negative roll yield will shift the analysis away from hedging. The relationships of forward premium or discount, initial difference in interest rates, positive or negative roll yield, and impact on hedging cost are summarized in Figure 21.2.

Figure 21.2: Forward Premiums or Discounts and Currency Hedging Costs

If the hedge requires:	**$F_{P/B} > S_{P/B}$, $i_B < i_P$** **The forward price curve is upward-sloping.**	**$F_{P/B} < S_{P/B}$, $i_B > i_P$** **The forward price curve is downward-sloping**
A long forward position in Currency B, the hedge earns:	Negative roll yield, which increases hedging cost and discourages hedging.	Positive roll yield, which decreases hedging cost and encourages hedging.
A short forward position in currency B the hedge earns:	Positive roll yield, which decreases hedging cost and encourages hedging.	Negative roll yield, which increases hedging cost and discourages hedging.

PROFESSOR'S NOTE

Suppose the initial forward price of the base currency is above its initial spot price. If the base currency is sold forward, F_T and S_T will converge at contract expiration and provide positive roll yield for the short position. The positive roll for the short position does not depend on whether the spot price increases or decreases. This is depicted in the figure below. It shows that the forward and spot price will converge at contract expiration regardless of whether the spot price increases or decreases. Suppose a manager sells the base currency forward when the initial forward price is above the spot price, $F_0 > S_0$. Convergence dictates that at contract expiration, $F_T = S_T$ and the roll return will be positive.



Note that the positive roll for the base currency short position is a negative roll for the long position. This discussion of roll and a contract on the base currency is equally true for contracts on any other assets such as stocks, bonds, and commodities.

Also note that the roll yield is not the total return from selling or buying the forward. The underlying spot price can increase or decrease. The forward price will converge to that unknown spot price at expiration of the forward. The total of the return to the forward position will be the change in price of the forward. That change in price of the forward has two components: 1) the unknown-in-advance change in the spot price, and 2) the known-in-advance roll yield.

EXAMPLE 8: Roll yield and interest rates

A USD-based investor has exposure to the South African rand (ZAR). The USD interest rate is 2.8% and the ZAR interest rate is 3.6%. **Determine** the roll yield for the investor if he hedges his ZAR exposure with a six-month forward.

Answer:

To hedge the long ZAR exposure, the investor sells the ZAR forward (buy the USD). IRP determines the premium or discount earned (roll yield) on the transaction. From IRP, the periodic risk-free rate of the currency purchased (USD) will be gained and the currency sold (ZAR) will be lost. Over a six-month period, this is approximately + 2.8% / 2 − 3.6% / 2 = –0.4%. The ZAR will trade at approximately a 0.4% forward discount.

A precise calculation of the discount requires first calculating the initial forward price using IRP:

$$F_{P/B} = S_{P/B}\left(\frac{1 + i_P}{1 + i_B}\right)$$

Then compare that forward price to the initial spot price to calculate the percentage roll yield (i.e., the forward premium or discount):

(F − S) / S

However by “assuming” an initial spot exchange rate between the two currencies of parity, a 1/1 exchange rate, this can be reduced to a single calculation:

% forward premium / discount = % roll yield

= $(1.00)(1.028 / 1.036)^{0.5} - 1 = –0.387\%$

Note that to analyze the ZAR, the ZAR is in the denominator of all terms.

PROFESSOR'S NOTE

The CFA text mentions but does not further apply a "similarity" between roll yield and trading the forward rate bias. Both depend on the initial interest rate differential between two currencies. In the previous example, the ZAR traded at a forward discount because it had an initially higher periodic interest rate.

- The forward rate bias trade (the carry trade) would buy the ZAR in the spot market to invest in and earn the higher interest rate.
- An investor who needs exposure to the ZAR would buy the ZAR in the forward market at a discount and earn positive roll yield.

The "similarity" is buying the higher yielding currency.

EXAMPLE 9: Hedging and roll yield

A portfolio's reporting currency is the Korean won (KRW) and the portfolio holds investments denominated in EUR, USD, and CHF. Current exchange rate information is provided below along with the manager's expectation for the spot rate in six months.

	Spot EX Rate	Six-Month Forward EX Rate	Manager's forecast
KRW/EUR	1,483.99	1,499.23	1,450.87
KRW/USD	1,108.78	1,112.56	1,146.63
KRW/CHF	1,265.22	1,257.89	1,212.55

1. Which foreign currencies trade at a forward premium or discount?
2. Which foreign currency hedges would earn a positive roll yield?
3. Which foreign currencies would an active currency manager hedge?
4. **Comment** on how the roll yield affects the decision to hedge the EUR or USD.
5. **Calculate** the implied unannualized roll yield of a currency hedged for the portfolio's long exposure to CHF.

Answers:

1. The EUR and USD trade at a forward premium; forward price is above spot price.
2. The hedge will require a forward sale of the currency and sale at a forward premium will earn positive roll yield. Those are the EUR and USD.
3. An active manager will selectively hedge those currencies where the hedge is expected to improve return. The manager will compare expected unhedged with hedged returns. The manager is initially long each foreign currency so increases in the currency's value are a gain.

	Unhedged		Hedged
	以forecast		以forward
EUR	(1,450.87 / 1,483.99) –1		(1,499.23 / 1,483.99) –1
	= –2.23%	<	= 1.03%
USD	(1,146.63 / 1,108.78) – 1		(1,112.56 / 1,108.78) – 1
	= 3.41%	>	= 0.34%

CHF (1,212.55 / 1,265.22) – 1 (1,257.89 / 1,265.22) – 1

= –4.16% < = –0.58%

Comparing unhedged expected returns with hedged returns, the manager will hedge the EUR and CHF.

4. Selling forward the USD and EUR will result in positive roll yield which will reduce hedging costs. However, roll yield is only one factor to consider. The positive roll yield for selling the USD forward is not as attractive as the expected appreciation of leaving the USD unhedged.
5. The implied roll yield is the forward premium or discount. It is also the hedged currency return:

$(F_0 – S_0) / S_0 = (F_0 / S_0) – 1 = (1{,}257.89 / 1{,}265.22) – 1 = –0.58\%$

This example demonstrates two issues involved with forward currency hedging. In essence, they are the same issue viewed from two different perspectives:

1. Positive (negative) roll yield will reduce (increase) hedging cost compared to the initial spot price.
2. Hedging locks in the forward price as an end of period exchange rate.

MODULE 21.5: IMPLEMENTATION AND OPTIONS

LOS 21.g: Describe trading strategies used to reduce hedging costs and modify the risk–return characteristics of a foreign-currency portfolio.

Video covering this content is available online.

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The initial forward premium or discount is one cost factor to consider in analyzing the cost/benefit of a currency hedge. To reduce hedging cost, the manager can increase the size of trades that earn positive roll yield and reduce the size of trades that earn negative roll yield.

Forward hedging also incurs **opportunity cost**. Locking in a forward price to hedge currency risk will eliminate downside currency risk but also will eliminate any upside opportunity for gain from changes in exchange rates. Discretionary or option-based hedging strategies are designed to reduce opportunity cost.

Perfect hedging is expensive. If the manager wishes to insure against downside risk and retain upside potential, costs rise further. Reducing those hedging costs involves some form of less downside protection or less upside opportunity, moving the portfolio away from a 100% hedge ratio and/or toward more active decision making. The following discussion of strategies applies to a manager who wishes to hedge long exposure to the CHF (the base currency) and quotations are EUR/CHF.

1. **Over- or under-hedge with forward contracts** based on the manager’s view. If the manager expects the CHF to appreciate, she can reduce the hedge ratio, hedging less than the full exposure to CHF risk. If the CHF is expected to depreciate, she can increase the hedge ratio, hedging more than the full exposure to CHF risk. If successful, this strategy creates “positive convexity”; gains will be increased and losses reduced. This is a relatively low cost strategy.

The rest of this discussion proceeds from roughly highest to lowest initial option cost.

S+P

2. **Buy at-the-money (ATM) put options** (also called **protective puts** or **portfolio insurance**). This strategy provides asymmetric protection, eliminating all downside risk and retaining all upside potential. But an at-the-money option is relatively expensive and has only time value (no intrinsic value). This strategy has the highest initial cost but no opportunity cost.
3. **Buy out-of-the-money (OTM) put options.** An ATM put would have a delta of approximately –0.50, called a 50-delta put because the sign of the delta is ignored with this terminology. Out-of-the-money puts have deltas that are smaller in magnitude than 0.50, so a 35-delta put is out of the money and a 25-delta put is further out of the money. Puts are less expensive the further they are out of the money, but also offer less downside protection. The manager will have downside CHF exposure down to the strike price of the puts. Compared to buying ATM protective puts, this strategy reduces the initial cost of the hedge but does not eliminate all downside risk.

P低-C高

4. **Collar**. The manager could buy the 35-delta puts on the CHF and sell 35-delta calls on the CHF. The OTM put provides some downside protection while costing less than an ATM put. The sale of the OTM call removes some upside potential (increasing opportunity cost) but generates premium income to further reduce initial cost. This strategy further reduces initial cost but also limits upside potential compared to buying out-of-the money put options only.

   A counterparty who buys the OTM call and sells the OTM put has taken on a risk reversal. The risk reversal profits if the underlying rises above the OTM call strike price and loses if the underlying falls below the OTM put strike price. The seller of the call and buyer of the put (used in the collar) can be described as short the risk reversal.

P低-P低低

5. **Put spread**. Buy OTM puts on the CHF and sell puts that are further out of the money, (e.g., buy a 35-delta put and sell a 25-delta put). There is downside protection, which begins at the strike price of the purchased puts, but if the CHF falls below the lower strike price of the put sold, that downside protection is lost. This strategy reduces the initial cost and also reduces downside protection compared to buying out-of-the money put options only.

P低-P低低-C高

6. **Seagull spread**. This is a put spread combined with selling a call (e.g., buy a 35-delta put, sell a 25-delta put, and sell a 35-delta call). Compared to the put spread, only this hedge has less initial cost and the same down side protection, but limits upside potential.

Further alternatives include varying the degree of upside potential and downside protection. The manager can vary the notional amounts of the options. For example, a 1 × 2 put spread would buy 100 40-delta puts and sell 200 30-delta puts. The sale of additional puts increases premium income, reducing the initial cost of the hedge, but doubles the downside risk if the currency value falls below the strike price on the 30-delta puts.

All of these strategies are considered "plain vanilla" in that they are combinations of standard options. **Exotic options** introduce features not found in standard options.

1. A **knock-in option** is a plain vanilla option that only comes into existence if the underlying first reaches some prespecified level.
2. A **knock-out option** is a standard option that ceases to exist if the underlying reaches some prespecified level.
3. **Binary** or **digital options** pay a fixed amount that does not vary with the difference in price between the strike and underlying price.

PROFESSOR'S NOTE

Clearly there are any number of combinations and odd names for hedging strategies that use combinations of options positions. The important thing is to recognize how the above strategies affect the tradeoff between the cost of a hedge, its downside protection, and its upside potential.

The issues involved with selecting a hedge are summarized in the following steps.

1. Determine the base currency in the P/B quote. In a USD/CHF quote, the CHF is the base and if the quoted price increases (decreases), the CHF appreciates (depreciates).
2. Determine whether the base currency will be bought or sold. If bought and the quoted price increases (decreases), there is a gain (loss). If sold and the quoted price increases (decreases), there is a loss (gain).
3. If buying the base currency is required to hedge the existing risk, buying forwards or calls can be used. Buying OTM calls or writing options will reduce the hedge cost but also reduce downside protection or upside potential.
4. If selling the base currency is required to hedge the existing risk, forwards are sold or puts are purchased. Buying OTM puts or writing options will reduce the hedge cost but also reduce downside protection or upside potential.
5. The higher the client's risk tolerance and the stronger the manager's views, the less likely a simple 100% hedge will be used.
6. Various combinations of options, strike prices, and position sizes can reduce initial hedging costs, even to zero, but only by reducing downside protection or upside potential.

HEDGING MULTIPLE CURRENCIES

International portfolios will typically have exposure to more than one foreign currency. Generally, hedging each exposure individually is unnecessary, expensive, and time consuming. Consider a European investor who is underweight the AUD and overweight the NZD. The mechanical solution is a long position in AUD and a short position in NZD to reach neutral weights in both. Because the Australian and New Zealand economies are very similar, their currencies exhibit strong positive correlation. The two currencies are natural hedges for each other. If the initial over- and underweights were equal, there may be no need for any additional hedging.

MODULE 21.6: MORE ADVANCED IMPLEMENTATION ISSUES

LOS 21.h: Describe the use of cross-hedges, macro-hedges, and minimum-variance-hedge ratios in portfolios exposed to multiple foreign currencies.

Video covering this content is available online.

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A **cross hedge** (sometimes called a **proxy hedge**) refers to hedging with an instrument that is not perfectly correlated with the exposure being hedged. Hedging the risk of a diversified U.S. equity portfolio with S&P futures contracts is a cross hedge when the portfolio is not identical to the S&P index portfolio. Cross hedges are generally not necessary in currency hedging because forward contracts for virtually all currency pairs are available but cross hedges may improve the efficiency of hedging.

Cross hedges also introduce additional risk to hedging. When the correlation of returns between the hedging instrument and the position being hedged is imperfect, the residual risk increases. The AUD and the NZD have a high positive correlation with each other so hedging an underweighting in the AUD with an overweighting in the NZD has little, but not zero, cross hedge risk.

The historical correlation is not a guarantee of the future. The future correlation may be different from historical correlation. If the correlation between two currencies moves toward zero, the (cross) hedge will not perform as expected. Portfolio performance could benefit or suffer from a change in correlation. The residual risk of the hedge is increased.

A **macro hedge** is a type of cross hedge that addresses portfolio-wide risk factors rather than the risk of individual portfolio assets. A bond portfolio might have interest rate risk, credit risk, and volatility risk exposures that the manager could hedge with bond futures (to hedge interest rate risk by modifying duration), credit derivatives (to hedge credit risk), and with volatility trading (to alter volatility risk).

One type of currency macro hedge uses a derivatives contract based on a fixed basket of currencies to modify currency exposure at a macro (portfolio) level. The currency basket in the contract may not precisely match the currency exposures of the portfolio, but it can be less costly than hedging each currency exposure individually. The manager must make a choice between accepting higher residual currency risk versus lower cost.

The **minimum-variance hedge ratio** (MVHR) is a mathematical approach to determining the hedge ratio. When applied to currency hedging, it is a regression of the past changes in value of the portfolio (R_{DC}) to the past changes in value of the hedging instrument to minimize the value of the tracking error between these two variables. The hedge ratio is the beta (slope coefficient) of that regression. Because this hedge ratio is based on historical returns, if the correlation between the returns on the portfolio and the returns on the hedging instrument change, the hedge will not perform as well as expected.

The practical implications of this are as follows:

1. Our forward hedging examples up to now have been "direct" hedges. For example, a USD portfolio that is long CHF 1,000,000 sells CHF 1,000,000 forward to hedge the risk, a simple one-for-one hedge ratio of the notional exposure. In technical terms, the portfolio is long CHF, the hedging vehicle is a

forward contract on the CHF, and the CHF and its forward have a virtually 1.00 correlation; therefore, no MVHR analysis is needed, sell CHF 1,000,000 forward.

2. Cross hedges or macro hedges are considered "indirect" hedges, the correlation between the currency exposure in the portfolio and a currency contract may not be 1.00 and the minimum-variance hedge ratio may not be one-for-one.
3. The MVHR can be used to jointly optimize over changes in value of R_{FX} and R_{FC} to minimize the volatility of R_{DC}.

   To illustrate this use of the MVHR, consider the case of a foreign country where the economy is heavily dependent on imported energy. Appreciation of the currency ($+R_{FX}$) would make imports less expensive, which is likely to decrease production costs, increasing profits and asset values ($+R_{FC}$). **Strong positive correlation between R_{FX} and R_{FC} increases the volatility of R_{DC}. A hedge ratio greater than 1.0 would reduce the volatility of R_{DC}.**

   Consider the case of a foreign country where the economy is heavily dependent on exports. Appreciation of the currency ($+R_{FX}$) would make its exports more expensive, likely reducing sales, profits, and asset values ($–R_{FC}$). **Strong negative correlation between R_{FX} and R_{FC} naturally decreases the volatility of R_{DC}. A hedge ratio less than 1.0 would reduce the volatility of R_{DC}.**

EXAMPLE 10: Determining and applying the MVHR

A U.S.-based portfolio is long EUR 2,000,000 of exposure. The portfolio manager decides to jointly hedge the risk of the asset returns measured in EUR and the risk of the currency return to minimize the volatility of the portfolio's returns measured in USD. The manager first adjusts all currency quotes to measure the value of the foreign currency by expressing the currency quotes as USD/EUR. He then calculates weekly percentage changes in value of the EUR (the R_{FX}) and unhedged percentage changes in value of the portfolio position measured in the portfolio's domestic currency (the R_{DC}). He performs a least squares regression analysis and determines based on the historical data that:

$$R_{DC} = 0.12 + 1.25(\%\Delta S_{USD/EUR}) + \varepsilon$$

With a correlation between R_{FX} and R_{FC} of 0.75

1. **Calculate** the size of and **state** the currency hedge to minimize expected volatility of the R_{DC}.
2. **Comment** on how effective the hedge is likely to be.

Answers:

1. EUR 2,000,000 × 1.25 = EUR 2,500,000; the manager will short EUR 2,500,000 to hedge a long EUR 2,000,000 exposure in the portfolio.
2. This is a cross hedge and is based on past correlation. The correlation can change and the hedge may perform better or worse than expected. In addition, a correlation of 0.75 is not perfect and there is random variation even in the past data.

MANAGING EMERGING MARKET CURRENCY

LOS 21.i: Discuss challenges for managing emerging market currency exposures.

The majority of investable asset value and FX transactions are in the six largest developed market currencies. Transactions in other currencies pose additional challenges because of: (1) higher transaction costs, "high markups" and (2) the increased probability of extreme events. Examples of these problems include the following.

- Low trading volume leads dealers to charge larger bid/asked spreads. The problem is compounded as the spreads tend to increase even further during periods of financial crisis.
- Liquidity can be lower and transaction costs higher to exit trades than to enter trades. Consider the carry trade that leads investors to gradually accumulate long positions in higher yield emerging market currencies. During periods of economic crises, the majority of those investors may attempt to exit a carry trade at the same time, driving the value of the emerging market currency down below its fundamental value and disrupting normal trading activity.

进易出难

- Transactions between two emerging market currencies can be even more costly. Few dealers have the expertise to directly make a market between the currencies of smaller markets. A dealer may quote a transaction between the Malaysian ringgit (MYR) and Hungarian forint (HUF) but would, in fact, execute component transactions in EUR/MYR and EUR/HUF with other dealers who have the expertise to trade only one of the two currencies.
- Emerging market currencies return distributions are non-normal with higher probabilities of extreme events and negative skew of returns. Many trading strategies and risk measures assume a normal distribution and are, therefore, flawed.
- The higher yield of emerging market currencies will lead to large forward discounts. This produces negative roll yield for investors who need to sell such currencies forward.
- Contagion is common. During periods of financial crisis the correlations of emerging markets with each other and with their currencies tend to converge toward +1.0. Both emerging markets and their currencies have declined as a group. At the very time diversification is most needed, it tends to disappear.
- There is *tail risk*; the governments of emerging markets tend to actively intervene in the markets for their currencies, producing long periods of artificial price stability followed by sharp price movements when market forces overwhelm the government's capacity to intervene. The "tail risk" refers to these negative events occurring more frequently than would be assumed in the normal distribution.

Non-deliverable forwards (NDFs): Emerging market governments frequently restrict movement of their currency into or out of the country to settle normal derivative transactions. Such countries have included Brazil (BRL), China (CNY), and Russia (RUB). NDFs are an alternative to deliverable forwards and require a cash settlement of gains or losses in a developed market currency at settlement rather than a currency exchange.

A benefit of NDFs is lower credit risk because delivery of the notional amounts of both currencies is not required. Only the gains to one party are paid at settlement.

An additional point to consider with NDFs is that they exist because the emerging market government is restricting currency markets. Changes in government policy can lead to sharp movements in currency values (i.e., there is tail risk).

EXAMPLE 11: Calculating cash settlement values for an NDF

A trader buys EUR 1,000,000 six months forward at RUB/EUR 39. Six months later, the spot exchange rate is RUB/EUR 40. **Calculate** the cash flows that will occur at settlement.

Answer:

The trader has agreed to "sell" RUB 39,000,000 for EUR 1,000,000. At settlement, the market value of EUR 1,000,000 is RUB 40,000,000 so the investor has a gain of RUB 1,000,000.

However, NDF settlements are made in the developed market currency at the ending spot exchange rate so we must convert the gain of RUB 1,000,000 to EUR at RUB/EUR 40.The EUR value of RUB 1,000,000 at settlement is 1,000,000 / 40 = 25,000 euros and the trader will receive this payment from the counterparty. There is only a net exchange of gain.

MODULE QUIZ 21.4, 21.5, 21.6

To best evaluate your performance, enter your quiz answers online.

1. Peter Perkins has a U.S.-based portfolio and decides to hedge his exposure to the Swiss franc (CHF) with a protective put strategy. However, he also decides he is willing to reduce the downside protection to lower the initial cost. Which of the following strategies will accomplish his objective?
   A. Buy 50-delta calls and puts on the CHF.
   B. Buy a 40-delta put and sell a 20-delta put on the CHF.
   C. Buy a 40-delta put and sell a 35-delta call on the CHF.
2. Jane Archer manages a Swiss-based (CHF) hedge fund. GBP 1,000,000 is currently invested in a diversified portfolio of U.K. stocks. Archer regresses the monthly returns of a diversified U.K. stock index (returns measured in CHF) versus the monthly change in value of the CHF/GBP. The regression coefficients are intercept = 0.11 and slope coefficient = 1.25. **Determine** the quantity of GBP Archer will short to implement a hedge of direct currency risk and a minimum-variance hedge.

	Direct currency hedge	Minimum-variance hedge
A.	GBP 1,000,000	GBP 1,000,000
B.	GBP 1,000,000	GBP 1,250,000
C.	GBP 1,250,000	GBP 1,250,000

3. A trader enters a short three-month non-deliverable forward on 2,000,000 CNY at CNY/USD 6.1155. At the end of the period, the spot exchange rate is USD/CNY 0.1612. The trader's gain or loss is *closest* to:
   A. USD 4,600 loss.
   B. USD 4,700 loss.
   C. USD 4,650 gain.

KEY CONCEPTS

LOS 21.a

An investment in assets priced in a currency other than the investor's domestic currency (a *foreign asset* priced in a *foreign currency*) has two sources of risk and return: (1) the return on the assets in the foreign currency and (2) the return on the foreign currency from any change in its exchange rate with the investor's *domestic currency*. These returns are multiplicative and an investor's returns in domestic currency can be calculated as:

Equation 1: $R_{DC} = (1 + R_{FC})(1 + R_{FX}) - 1 = R_{FC} + R_{FX} + (R_{FC})(R_{FX})$

$R_{DC} \approx R_{FC} + R_{FX}$

Equation 2: $R_{DC} = \sum_{i=1}^{n} w_i (R_{DC,i})$

Equation 3: $\sigma^2(R_{DC}) \approx \sigma^2(R_{FC}) + \sigma^2(R_{FX}) + 2\sigma(R_{FC})\sigma(R_{FX})\rho(R_{FC},R_{FX})$

Equation 4: $\sigma(R_{DC}) = \sigma(R_{FX})(1 + R_{FC})$

where for Equation 4:

R_{FC} = the return on a foreign currency denominated risk-free asset

LOS 21.b

Passive hedging is rule-based and typically matches the portfolio's currency exposure to the portfolio's benchmark in order to eliminate currency risk relative to the benchmark.

Discretionary hedging allows the manager to deviate modestly from passive hedging. The primary goal is currency risk reduction while seeking some modest value added return.

Active currency management allows wider discretion to selectively hedge or not hedge and to deviate substantially from the benchmark. The goal is value added, not risk reduction. At the extreme, an active manager can treat currency as an asset class and take positions independent of the portfolio assets. For example, a manager who is bearish on the Swedish krona (SEK) can short the SEK even if no SEK assets are owned.

Currency overlay management is a broad term referring to the use of a separate currency manager. The asset manager first takes positions in the markets considered most attractive, without regard to the resulting currency exposures. The overlay manager then adjusts the currency exposures. The overlay manager's mandate can be passive, discretionary, or active.

Arguments made for not hedging currency risk include the following:

- Avoid the time and cost of hedging or trading currencies.

- Currency effects are a “zero-sum game”; if one currency appreciates, another must depreciate.
- In the long run, currencies revert to a theoretical fair value.

Arguments for active currency management include the following:

- In the short run, currency movement can be extreme.
- Inefficient pricing of currencies can be exploited to add to portfolio return. Inefficient pricing of currency can arise as many foreign exchange (FX) trades are dictated by international trade transactions or central bank policies.

LOS 21.c

Factors that favor a benchmark neutral or fully hedged currency strategy are:

- A short time horizon for portfolio objectives.
- High risk aversion.
- High short-term income and liquidity needs.
- Significant foreign currency bond exposure.
- Low hedging costs.
- Clients who doubt the benefits of discretionary management.
- A client who is unconcerned with the opportunity costs of missing positive currency returns.

LOS 21.d

1. Economic fundamentals assumes that purchasing power parity (PPP) determines exchange rates in the very long run. In the shorter run, currency appreciation is associated with:
   - Currencies that are undervalued relative to fundamental value (based on PPP).
   - Currencies with a faster rate of increase in fundamental value.
   - Countries with lower inflation.
   - Countries with higher real or nominal interest rates.
   - Countries with a decreasing country risk premium.
2. Technical analysis:
   - Overbought (or oversold) currencies reverse.
   - A currency that declines to its support level will reverse upward unless it pierces the support level, in which case, it can decline substantially.
   - A currency that increases to its resistance level will reverse downward unless it pierces the resistance level, in which case, it can increase substantially.
   - If a shorter term moving average crosses a longer term moving average, the price will continue moving in the direction of the shorter term moving average.

3. The carry trade exploits the forward rate bias (i.e., forward exchange rates are not a valid predictor of currency market movement).
    - Borrow the lower interest rate currency (often a developed market).
    - Convert it to the higher rate currency (often an emerging market) at the spot exchange rate.
    - Invest and earn the higher interest rate.

    This is a risky, not a hedged, trade. If the higher interest rate currency appreciates or depreciates less than "implied" by the forward rate, the trade will be profitable. In times of severe economic stress, the carry trade can be very unprofitable as the higher interest rate (and riskier) currency collapses.
4. Volatility trading profits from changes in volatility.
    - If volatility is expected to increase, enter a straddle (purchase a call and put with the same strike price, typically using at-the-money options). A strangle (buy an out-of-the-money call and put) can also be used. The strangle will cost less but will have less upside if volatility increases.
    - If volatility is expected to decline, enter a reverse straddle or strangle (i.e., sell the options).

LOS 21.e

Expectation:		**Action:**
Relative currency:	Appreciation	Reduce the hedge (short position) on **OR** increase the long position in the currency
	Depreciation	Increase the hedge on or decrease the long position in the currency
Volatility:	Rising	Long straddle (or strangle)
	Falling	Short straddle (or strangle)
Market conditions:	Stable	A carry trade
	Crisis	Discontinue the carry trade

LOS 21.f

Typically, forward contracts are preferred for currency hedging because:

- They can be customized, while futures contracts are standardized.
- They are available for almost any currency pair, while futures trade in size for only a limited number of currencies.
- Futures contracts require margin which adds operational complexity and can require periodic cash flows.
- Trading volume of FX forwards and swaps dwarfs that of FX futures, providing better liquidity.

A hedge can be a **static hedge**, which is established and held until expiration, or a **dynamic hedge**, which is periodically rebalanced.

The choice of hedging approach should consider:

- Shorter term contracts or dynamic hedges with more frequent rebalancing tend to increase transaction costs but improve the hedge results.
- Higher risk aversion suggests more frequent rebalancing.
- Lower risk aversion and strong manager views suggest allowing the manager greater discretion around the strategic hedging policy.

Hedging also exposes the portfolio to **roll yield** or **roll return**. Roll yield is a return from the movement of the forward price over time toward the spot price of an asset. It can be thought of as the profit or loss on a forward or futures contract if the spot price is unchanged at contract expiration.

Forward Premiums or Discounts and Currency Hedging Costs

If the hedge requires:	$F_{P/B} > S_{P/B}$, $i_B < i_P$ **The forward price curve is upward-sloping.**	$F_{P/B} < S_{P/B}$, $i_B > i_P$ **The forward price curve is downward-sloping**
A long forward position in Currency B, the hedge earns:	Negative roll yield, which increases hedging cost and discourages hedging.	Positive roll yield, which decreases hedging cost and encourages hedging.
A short forward position in currency B the hedge earns:	Positive roll yield, which decreases hedging cost and encourages hedging.	Negative roll yield, which increases hedging cost and discourages hedging.

LOS 21.g

The cost of hedging a currency exposure:

- **Positive roll** will reduce and **negative roll** will increase hedging costs.
- Hedging with forward (or futures) has no explicit option premium cost, but it has **implicit cost**; it removes upside as well as downside.
- Active managers can selectively **over- or under-hedge**. Buy more or sell less of the currency expected to appreciate.
- An **at-the-money (ATM) put** (a **protective put** or **portfolio insurance**) is the most expensive (upfront premium cost) form of option hedging (e.g., buy a 50 delta put).

Option hedging costs can be reduced by decreasing upside potential or increasing downside risk. To hedge an existing currency exposure:

- **Buy an out-of-the-money (OTM) put.**
- **Use a collar; buy an OTM put and sell an OTM call.**
- **Use a put spread; buy an OTM put and sell a further OTM put.**
- **Use a seagull spread; buy an OTM put, sell a further OTM put and sell an OTM call.**

- **Use exotic options** that require addition conditions before they can be exercised or which can expire early.

LOS 21.h

A **cross hedge** (sometimes called a proxy hedge) uses a hedging vehicle that is different from, and not perfectly correlated with, the exposure being hedged.

A **macro hedge** is a type of cross hedge that addresses portfolio-wide risk factors rather than the risk of individual portfolio assets. One type of currency macro hedge uses a derivatives contract based on a fixed basket of currencies to modify currency exposure at a macro (portfolio) level.

The **minimum-variance hedge ratio** (MVHR) is a mathematical approach to determining the hedge ratio. Regress past changes in value of the portfolio (RDC) to the past changes in value of the hedging instrument (the foreign currency) to find the hedge ratio that would have minimized standard deviation of RDC. The hedge ratio is the beta (slope coefficient) of that regression.

- Positive correlation between R_{FX} and R_{FC}; MVHR > 1.
- Negative correlation between R_{FX} and R_{FC}; MVHR < 1.

LOS 21.i

Non-deliverable forwards (NDFs) settle the net gain or loss in a single currency (rather than exchanging currencies).

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 21.1

1. **C** The ending value in USD is: USD 1,253,000 × 1.05 = USD 1,315,650.The ending value in DJF is: USD 1,315,650 × DJF/USD 192.85 = DJF 253,723,103. (LOS 21.a)
2. **C** (1 + RFC)(1 + RFX) − 1

   (1.05)(192.85 / 179.54) − 1 = 12.78% (LOS 21.a)
3. It depends on the standard deviation of the asset returns measured in the foreign currency, the standard deviation of the currency, and the correlation between these two sources of return.

   Variance = $(1.0^2)(4.5^2) + (1.0^2)(3.7^2) + 2(1.0)(1.0)(0.81)(4.5)(3.7) = 60.913$

   Standard deviation = 7.8%

   (LOS 21.a)
4. **A** The manager's market views affect tactical decisions to vary away from the strategic decision. The portfolio and market circumstances determine the strategic decision. (LOS 21.b)
5. **C** Any of the following will shift the portfolio toward active currency management allowing greater manager discretion:
   - A long time horizon for portfolio objectives.
   - Low risk aversion.
   - Concern with regret at missing opportunities to add value through discretionary currency management.
   - Low short-term income and liquidity needs.
   - Little foreign currency bond exposure.
   - High hedging costs.
   - Clients who believe in the benefits of discretionary management.

   (LOS 21.b)
6. The case states that Simms must hold a long position in the KRW and her long futures position is coming due. She must roll it over with another long position. She does have the authority to increase or decrease the long hedge position by 10%. Because she believes the KRW will depreciate, she should reduce the hedge size 10% and will buy only 900,000 KRW rather than the existing 1,000,000 when she rolls over the hedge. The quotes are given in EUR/KRW so she must transact at the higher price of 0.00068 reflecting she is paying more EUR per KRW. The spot quote is given in five decimal places so the forward points

decimal must be moved five places to the left for a forward price of 0.00068 – (1.1 / 100,000) = 0.00068 – 0.000011 = 0.000669 EUR/KRW. (LOS 21.a)

7. a. The expected returns measured in the investor's domestic currency (CHF) are:

   EUR asset: (1.02)(0.99) – 1 = +0.98%

   AUD asset: (1.025)(1.03) – 1 = +5.58%

   The weighted average return is: 0.6(0.98%) + 0.4(5.58%) = 2.82%

   b. The standard deviations of asset returns measured in the investor's domestic currency are:

   EUR asset: [(15.02) + (7.02) + 2(15.0)(7.0)(0.85)]1/2 = 21.27%

   AUD asset: [(25.02) + (9.02) + 2(25.0)(9.0)(0.65)]1/2 = 31.60%

   The standard deviation of portfolio returns is:

   [0.62(21.272) + 0.42(31.602) + 2(0.6)(0.4)(0.70)(21.27)(31.60)]1/2 = 23.42%

   c. The expected returns measured in the investor's domestic currency (CHF) are:

   EUR asset: (1.02)(0.99) – 1 = +0.98%

   AUD asset: (1.025)(1.03) – 1 = +5.58%

   The weighted average return is: –1.5(0.98%) + 1.5(5.58%) = 6.90%

   d. The standard deviations of asset returns measured in the investor's domestic currency are:

   EUR asset: [(15.02) + (7.02) + 2(15.0)(7.0)(0.85)]1/2 = 21.27%

   AUD asset: [(25.02) + (9.02) + 2(25.0)(9.0)(0.65)]1/2 = 31.60%

   The standard deviation of portfolio returns is:

   $[(–1.5)^2(21.27^2) + (1.5)^2(31.60^2) + 2(–1.5)(1.5)(0.70)(21.27)(31.60)]^{1/2}$ = 33.87%

   (LOS 21.a)

Module Quiz 21.2, 21.3

1. **C** A carry trade should be more profitable in periods of economic stability (low, stable currency volatility) with lower interest rates in the borrowing currencies and higher interest rates in the investing currencies. (Module 21.3, LOS 21.d)

2. **C** Rising real interest rates in the euro zone would attract capital and be associated with a rising currency value, leading a manager to tilt to a long position in the euro. The other two answers are incorrect. Low volatility is favorable to a carry trade. Rising volatility increases the price of both calls and puts. It is likely to have a greater impact on the cost of the protective put, which requires purchase of a put. In contrast, the collar cost is increased to purchase the put but offset by an increased receipt from selling the call. (Module 21.3, LOS 21.d)

Module Quiz 21.4, 21.5, 21.6

1. **B** This question requires you select the strategy that meets the objectives set by Perkins. He has three objectives and only one answer choice meets all three. He wants a protective put on the CHF; all three strategies buy a put on the CHF. He wants to lower the initial cost; one strategy buys a call, which will raise the cost, but it must be rejected. He is willing to reduce his downside protection in order to lower the initial cost; the only one strategy to do this is the buy a 40-delta put and sell a 20-delta put on the CHF. Note the strategy that sells an OTM call also lowers the initial cost but does so by limiting upside; this is not what Perkins specified. (Module 21.5, LOS 21.g)
2. **B** A direct currency hedge is a simple 1.0 hedge ratio; Archer will sell 1,000,000 GBP forward. A MVHR considers the correlation between returns of the foreign asset measured in the portfolio’s domestic currency and change in value of the foreign currency. The hedge ratio is the beta (slope coefficient) of the regression. Archer will sell 1,250,000 GBP forward. (Module 21.6, LOS 21.h)
3. **C** An NDF settles in the developed market currency; however, the information is presented in a mixture of CNY/USD and USD/CNY which requires additional steps:

   Determine the size of the trade in USD at the forward exchange rate:

   CNY 2,000,000 / (CNY/USD 6.1155) = USD 327,037.85

   Determine the G/L on the USD position in CNY. The two exchange rates need to be in CNY/USD.

   Ending spot exchange rate USD/CNY 0.1612 is CNY/USD 6.20347.

   G/L = (CNY/USD 6.20347 − 6.1155) × 327,037.85 = CNY 28,769.52

   Determine the G/L in USD based on ending spot exchange rate is:

   G/L = CNY 28,769.52 × USD/CNY 0.1612 = USD 4,637.65

   The CNY was shorted at CNY/USD 6.1155 and declined in value to CNY/USD 6.20347 producing a gain on the trade of USD 4,637.65.

   (Module 21.6, LOS 21.i)

TOPIC ASSESSMENT: ASSET ALLOCATION

Use the following information for Questions 1 through 6.

Tyler Robinson, CFA, a senior analyst at RNC Investments, is reviewing the investment policy statements (IPS) of two new RNC clients.

Bob Carlson, is a 45-year-old seasoned investor who prefers to take a strategic approach to allocating his assets. Carlson has just moved his account from Aggressive Investments (AI) to RNC because he was uncomfortable with the 12% return AI was promising its clients. Carlson knew that this return was only achievable with an increased level of risk-taking. Robinson interviews Carlson to determine his spending rate and his risk aversion score. They agree that a 3% after-tax return should cover his spending needs on an annual basis and that his risk aversion score is 8 out of 10.

Rick Olsen is a 22-year-old recent college graduate who believes in monitoring his portfolio on a daily basis and capitalizing on perceived mispricings. Olsen has just opened up his first investments account through RNC. RNC was recommended by one of his college finance professors who has a son working at RNC. Olsen would like to manage his own investments, but his new job requires him to work 60 hours a week, so he hired RNC. Robinson discusses the same two issues that he covered with Carlson. He concludes a 5% after-tax return is enough to cover Olsen's spending needs and that Olsen's risk aversion is much lower at a score of 2.

After gathering this client data, Robinson specifies the asset class data he will use for the strategic asset allocation. His initial plan is for a tradition mean variance optimization (MVO) that will allow the greatest possible diversification for each investor. To do so, he specifies that each asset class will:

1. Have similar attributes to the other asset classes from both a descriptive and statistical perspective.
2. Be specified in such a way that any single asset qualifies for inclusion in only one asset class.
3. Be liquid enough to allow transaction at reasonable cost.

Robinson later decides his initial approach is too data intensive and instead decides to limit the asset classes he will consider. He consults his firm's economist and gathers the following data on four asset classes. He notices he will need to adjust this data because the returns are given as percentages, but the risk is in decimal (not percentage) numbers:

Asset Class and Name	Expected Return	Expected Standard Deviation
A, U.S. Large-Cap	8.5%	0.15
B, U.S. Small-Cap	12%	0.20
C, U.S. Fixed Income	5.5%	0.03
D, Real Estate	7.0%	0.12

Using only this return and risk data plus a correlation matrix, Robinson then creates four portfolios. For the four portfolios, he calculates pre-tax expected returns, standard deviations, and Sharpe ratios.

Portfolio	**Exp. Return**	**Exp. Std. Dev.**	**Sharpe Ratio**	**Asset Class Weights %**			
				A	*B*	*C*	*D*
1	6.50%	5.95%	0.756	12	13	5	70
2	7.25%	8.30%	0.633	22	5	21	52
3	8.00%	11.15%	0.538	32	18	15	35
4	8.75%	14.25%	0.474	42	21	22	15

Robinson reviews his notes and verifies that Carlson and Olsen both have taxable and tax-exempt accounts where they can locate (hold) assets. Both clients are taxed at 25%. To assign rebalancing ranges, he analyzes the relevant variables and determines suitable ranges for their tax-exempt accounts. For example, if he determines that the allocation to an asset in Olsen's tax-exempt account is 32% with a deviation of 10%, the range would be 22 to 42%.

Robinson is also preparing for a round of client presentations. He prepares the following discussion points to use with his more sophisticated clients regarding issues associated with strategic asset allocation.

A. Allocating a portfolio between risk-free and the tangent portfolio on the efficient frontier is superior to selecting portfolios from the efficient frontier. It not only produces superior excess return to risk, it is simpler and the necessary risk-free assets are readily available.

B. Neither asset-only nor liability-relative asset allocation is necessarily superior. The choice depends on client circumstances. Foundations and endowments normally focus on asset only, but banks focus on liability-relative approaches.

C. Basic MVO has some practical problems. We can instead use Black-Litterman to solve for expected returns by asset class and then adjust those returns as we see appropriate. Or, we can use resampling to solve for a weighted average combination of asset classes that provides an efficient combination of risk and return.

1. Assuming Robinson recommended portfolio 1 to Carlson and portfolio 4 to Olsen, the utility-adjusted returns for both investors would be *closest* to:
   A. 6.72% for Olsen and 6.26% for Carlson. Um=ER-0.005*lambda*Var
   B. 5.08% for Carlson and 6.72% for Olsen.
   C. 6.26% for Carlson and 8.61% for Olsen.

2. Regarding Robinson's specification of asset class, which specification is *least accurate*?
   A. Specification 1.

B. Specification 2.
C. Specification 3.

3. What approach to asset allocation is Robinson *most likely* using?
   A. Black-Litterman.
   B. Resampled MVO.
   C. Mean-variance optimization (MVO).

4. If Carlson and Olsen hold assets in their tax-exempt accounts instead of taxable accounts:
   A. the after-tax return will exceed the pre-tax return.
   ?
   B. the same correlation data will apply to both accounts.
   C. the rebalancing range in the taxable account may be skewed to allow less deviation above the target weight.

5. In the example about locating an asset in Olsen's tax-exempt account with a target weight of 32% and a deviation of 10%, the allowable rebalancing range if Olsen locates the asset in his taxable account will be *closest* to:
   A. 25 to 39%.
   B. 19 to 45%.
   C. 29 to 55%.

6. Which of Robinson's presentation points is *least accurate*?
   A. Point A.
   B. Point B.
   C. Point C.

Use the following information for Questions 7 through 12.

Mary Freer is a portfolio manager for the Worldwide Investors Mutual Fund (Worldwide), a U.S. portfolio manager based in New York. Kate McLaughlin, a recent college graduate, is her assistant.

Freer is scheduled to give a presentation next week where she will discuss currency hedging issues. It will be a diverse group including more, as well as less, sophisticate investors. All the clients are based in the United States. Because the managers at Worldwide often use currency hedges and base the hedging decisions on a variety of factors, she asks McLaughlin to prepare summary statements that describe various client, as well as broad market and economic, factors that affect the decision to hedge. McLaughlin prepares two lists.

We are more likely to hedge to reduce currency risk in accounts:

1. With shorter time horizon and higher liquidity needs.
2. With greater allocation to foreign equity compared to accounts with larger foreign bond exposure.
3. Where the client is unsophisticated and does not understand why currency affects the rate of return.

In the second list, she states that we are more likely to expect appreciation in value of currencies that:

1. Trade at a forward premium (current forward price exceeds the spot price of the currency).
2. With higher relative interest rates.
3. With higher relative volatility.

She also asks McLaughlin to prepare a simple and complex example she can discuss at the presentation. McLaughlin provides the following:

Simple example: The foreign market will appreciate 6%, and the foreign currency will depreciate 3%. The foreign currency currently trades at a 2% forward discount.

Complex example: We hold a portfolio of European stocks, currently worth €300,000. The spot exchange rate is $1.10/€. We hedge the currency risk with a three-month futures contract on the euro at $1.15/€. A week later, the portfolio is worth €320,000, the spot exchange rate is $1.20/€, and the futures exchange rate is $1.23/€.

At the presentation, Freer is asked to discuss how Worldwide uses minimum-variance hedge ratio. She states:

- The minimum-variance hedge ratio is derived by regressing the unhedged return on the foreign stock in USD terms against the return on the currency futures contract.
  Rdc=Beta*Rheding instr+epsilon
  Beta->MVHR
- The advantage of this hedging approach is it captures the relationship between market and currency return. Suppose we invest in a foreign equity market and that currency depreciates. But this stimulates export sales, leading to increased profits and stock prices. That scenario would affect our hedge ratio. The MVHR will exceed a naïve hedge ratio 1. rho<0 => Beta, MVHR<1

She is also asked how basis risk can complicate hedging currency risk. She responds that:

1. Basis risk is unpredictable in the short run. But when we sell currencies at a forward premium, it will provide positive roll return over the long run.
2. We can reduce basis risk by assuring that the expiration of the contract is longer than our anticipated holding period. X
3. Rolling over shorter-term contracts to reach our desired longer hedging period will improve the accuracy of our currency hedge, and by using forward contracts we avoid any cash flow issues until the end of the hedging period. X

7. Regarding McLaughlin's first list, which client factor summary statement is *most likely* incorrect?
   A. 1.
   B. 2.
   C. 3.

8. Regarding McLaughlin's second list, which broad market factor summary statement is *most likely* correct?
   A. 1
   B. 2.
   C. 3.

9. In McLaughlin's simple example and for an account that actively manages currency risk:
   A. the unhedged currency return of the investment is approximately 9%.
   B. the hedged currency return of the investment is approximately 6%.
   C. Freer would hedge the currency risk.

10. In McLaughlin's complex example and for an account that actively manages currency risk, the hedged currency return is *closest* to:
   ? A. 16.4%.
   B. 6.7%.
   C. 9.1%.

11. Regarding Freer's statements concerning the minimum-variance hedge ratio, she is:
   A. correct.
   B. incorrect regarding how to calculate a MVHR..
   C. incorrect in stating her example will lead to a MVHR > 1.0.

12. Regarding McLaughlin's statements concerning basis risk:
   A. all three are correct.
   B. only two of the statements are correct.
   C. only one of the statements is correct.

TOPIC ASSESSMENT ANSWERS: ASSET ALLOCATION

1. **B** After adjusting the risk to percentages:

   Portfolio 1 has an expected return of 6.5% and an expected standard deviation of 5.95%. Given Carlson's risk aversion score of 8, his utility-adjusted return would be:

   Var?

   $$UP = 6.5\% - 0.005(8)(5.95^2) = 5.08\%$$

   Portfolio 4 has an expected return of 8.75% and an expected standard deviation of 14.25%. Given Olsen's risk aversion score of 2, his utility-adjusted return would be:

   $$UP = 8.75\% - 0.005(2)(14.25^2) = 6.72\%$$

   (Study Session 9, Module 19.1, LOS 19.a)

2. **A** Asset classes have been appropriately specified if:
   - Assets in the class are similar from a descriptive as well as a statistical perspective (homogeneous). Robinson got this one wrong because he is saying the classes should be similar to each other. The classes should be different from each other as specified in the next point.
   - They are not highly correlated, so they provide the desired diversification.
   - Individual assets cannot be classified into more than one class (mutually exclusive). This is his second point.
   - They cover most possible investable assets.
   - They contain a sufficiently large percentage of liquid assets. This is his third point.

   Note that in the next question he consciously decides to limit the number of asset classes he considers. This is normal and he does it in a reasonable manner, including equity, fixed income, and an alternative investment. (Study Session 9, Module 18.3, LOS 18.d)

3. **C** He uses the basic inputs of MVO. The Black-Litterman would have used market asset class weights and solved for expected returns. Resampling would have used multiple sets of MVO inputs, not one set. (Study Session 9, Module 19.3, LOS 19.b, 19.i)

4. **B** Correlation data is a market-level issue and is not affected by the individual investor's tax situation; thus, the same correlation matrix applies to both tax locations. After-tax return will be less than pre-tax return, not more. The rebalancing range in the taxable account may be skewed to allow less deviation below (not above) the target weight to encourage realizing losses. Realizing losses can have tax benefits. (Study Session 10, Module 20.1, LOS 20.b)

5. **B** We are given Olson's tax rate, target weight, allowable deviation, and range for his taxexempt account. Because taxes reduce volatility and risk, ranges can be wider in the taxable portfolio.

   deviation after-tax = deviation pre-tax / (1 – t) = 10 / (1 – 0.25) = 13.33%

   With a target weight of 32% that makes the rebalancing range in the taxable account:

   32 +/– 13.33 = 18.67 to 45.33%

   (Study Session 10, Module 20.1, LOS 20.b)

6. **A** Point A is incorrect. It is describing a capital allocation line between the risk-free asset and efficient frontier. The error is in failing to understand what risk-free means in this context. Risk-free would mean an asset with zero volatility and zero correlation to all other asset classes. In most situations, no such asset exists. In practical terms, most portfolios are built using efficient frontier concepts and combinations of risky assets. Cash is mainly used to meet liquidity needs.

   Point B and C are consistent with the direct coverage and discussions in the text. (Study Session 9, Module 18.2, LOS 18.b; Study Session 9, Module 18.5, LOS 18.g; Study Session 9, Module 19.3, LOS 19.b, 19.i)

7. **B** Because equity is a more volatile asset class than bonds, the added risk of currency in a foreign equity investment is relatively less significant than in a foreign bond investment. The statement got this backwards and is incorrect.

   The other two are true. Shorter time horizon and greater liquidity needs lower risk tolerance and therefore make hedging the currency risk more likely. An unsophisticated client who does not understand currency is likely to be more confused by the incremental variability of return it adds. Hedging the currency risk will make the investment somewhat more predictable. (Study Session 10, Module 21.1, LOS 21.b, 21.c)

8. **B** Currencies with higher relative interest rates tend to attract capital and appreciate in value.

   The other two are false. The forward premium is a direct reflection of the IRP currency arbitrage. A forward premium is caused by a relatively lower interest rate and that is associated with currency depreciation. Note that a common misconception is that the forward currency exchange rate is a valid predictor of what will happen to the value of a currency. That is not supported by the CFA® material or by most empirical evidence. High volatility is a sign of distress, not of an undervalued currency. (Study Session 10, Module 21.3, LOS 21.d)

9. **C** The unhedged return is approximately 6 – 3 = 3%. The hedged currency return is approximately 6 – 2 = 4%. Therefore hedged is best. (Study Session 10, Module 21.4, LOS 21.f)

10. C Because this question involves specific beginning and ending amounts of an investment in a foreign denominated asset and G/L on currency contracts, we need to work through a variation of ending – beginning value in the investor's currency, the USD.

G/L in USD on the unhedged investment is:

(EUR320,000 × USD1.20/EUR) – (300,000 × 1.10) = (384,000 – 330,000) = USD54,000

G/L on the contracts is:

EUR300,000 × (USD1.15/EUR – 1.23) = –USD24,000

This is a loss as the EUR was sold forward and contract price declined.

The total gain versus BV in USD on the hedged investment is:

USD30,000 / (EUR300,000 × USD1.10/EUR) = 9.09%

There are various ways you can arrange this sequence of calculations, provided you come to the correct final result of 9.1%. If you simply solved for RFC and RFX, then added or compounded them together, that is not correct when a question involves specific beginning and ending amounts of an investment in a foreign denominated asset and G/L on currency contracts. (Study Session 10, Module 21.4, LOS 21.f)

11. **C** Freer is correct regarding how to calculate a MVHR. She is wrong regarding the numeric value of a MVHR. She describes a situation of negative correlation between RFC (the stock market increases) and RFX (the foreign currency depreciates). When there is negative correlation, one risk naturally tends to offset the other, lowering the MVHR. (Study Session 10, Module 21.6, LOS 21.h)

12. **C** She is correct that basis risk is unpredictable in the short. Basis is change in futures versus change in spot price, and those prices are determined by market conditions. But if a contract is held to expiration, F and S converge and the roll return is certain. It is the initial difference in F and S. She sold at a premium so that roll is positive. ?

She is wrong about buying shorter or longer contracts. To reduce basis risk, she should buy contracts that match the hedging period. She is also wrong about cash flow. It is true forwards have no daily margin flow, but every time she rolls a contract there will be realized G/L to settle up with an exchange of funds. (Study Session 10, Module 21.4, LOS 21.f)

The following is a review of the Fixed-Income Portfolio Management (1) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #22.

READING 22: FIXED-INCOME PORTFOLIO MANAGEMENT: INTRODUCTION

Study Session 11

EXAM FOCUS

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

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

MODULE 22.1: ROLE OF FIXED INCOME

LOS 22.a: Discuss roles of fixed-income securities in portfolios.

CFA® Program Curriculum, Volume 4, page 6

Video covering this content is available online.

Fixed income is the largest segment of world financial markets. (Real estate may be larger but is not being treated as a financial market in this comment.) The fixed-income market is highly varied. It includes publically traded securities such as bond and money market securities as well as nonpublic instruments such as loans and private placement securities. It varies by maturity and credit quality segments. There are structure differences such as straight bonds without embedded options, instruments with embedded prepayment options, variable coupon structures, and inflation adjustment features.

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

1. *Diversification*. In general, fixed income has low correlation to equity markets. Adding an asset class to an existing portfolio with a correlation of less than +1 means the same expected return can be generated with lower standard deviation and the standard deviation of the portfolio will be less than the weighted average standard deviation of the assets held in the portfolio. The lower the correlation, the greater the diversification benefit. Specific correlation numbers vary by time period and type of instrument used. For 2003 to 2015, the correlations of various

fixed-income indexes to the S&P 500 equity index fell within a range of –0.35 to +0.36.

In general, various U.S. investment grade (IG) segments had relatively high correlation with each other. International IG was less correlated to U.S. IG and offered additional diversification within fixed income. High yield [(HY) means below investment grade] and emerging market fixed income had low correlation to investment-grade fixed income and offered significant diversification within fixed income, but they were also the most correlated to equity markets and so provided the least diversification benefit if it were the only fixed income added to equity portfolios. (There was still a diversification benefit, just less pronounced.)

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

While correlation is an important component of reducing portfolio risk, so is the standard deviation of the assets added. In general, bonds have lower standard deviation than equity, and that also reduces the overall risk of the portfolio. However, the same caveat exists, that bond volatility may increase during market crises.

2. *Regular cash flow.* Most fixed income provides regular, predictable cash flow that investors can use to meet expected future obligations. This is convenient for an individual needing regular living expenses or specific periodic expenditures such as college tuition payments. Institutions such as insurance companies that must make periodic payments to policyholders could structure and dedicate a portfolio of bond assets to meet these payouts. Investors could also build a buy-and-hold laddered portfolio of bonds to provide regular cash flow. Buy and hold means no sales or trading are planned, and laddered means a somewhat equal amount of par comes due periodically. Implicit in this discussion is that there is no significant credit risk and that all payments will be made on the bonds.
3. *Inflation hedge.* While not the first thing most investors would think of, some types of bonds do provide forms of inflation protection. Standard fixed-coupon (nominal rate) bonds do not. For simplicity, assume the bonds are purchased at par so that initial yield is the coupon rate. The purchase yield and coupon reflect nominal compensation for an expected future rate of inflation and a real return above that rate of inflation. If inflation increases, the coupon cash flow is fixed and the investor suffers on an inflation-adjusted basis. Looked at another way, the yield a new investor would want increases and the price of the bond must decline.
    - Inflation-linked (also called real rate or real return) bonds provide direct protection for the effect of inflation. Like regular bonds, the coupon payment amount is the coupon rate × par. But unlike regular bonds, the par adjusts for inflation. If 1 million par is purchased and inflation is 5%, the par

increases by 5% to 1.05 million. (For later comparison with floating-coupon bonds, assume the previous inflation rate was 3%, though this does not directly affect the calculations for the inflation-linked bond.) That leads the coupon payment amount to increase by 5% as well. For example, if the real rate were 0.5%, the first (annualized) coupon payment is 5,250 (1,050,000 × 0.005). This adjustment continues every period to compensate for cumulative inflation over the life of the bond. At expiration, inflation-adjusted par is paid to the investor. Thus, both coupon payments and par are inflation protected.

- Floating-coupon (floating-rate) securities also provide inflation protection. The coupon rate is set by a formula such as LIBOR + 100 basis points. If inflation and LIBOR are initially 3.0% and 3.5%, the first (annual) coupon payment on 1 million par would be 45,000 [1,000,000 (0.035 + 0.01)]. If inflation then increases by 2% to 5.0%, it is likely LIBOR will also increase by 2% to 5.5% and the next coupon payment will increase to 65,000 [1,000,000 (0.055 + 0.01)]. No adjustment is made to the par amount. Thus, it is said the coupons are inflation protected but not the principal.

Figure 22.1: Summary of Inflation Protection

	Coupon	Par
Fixed-coupon bonds	Not protected	Not protected
Inflation-linked bonds	Protected	Protected
Floating-coupon bonds	Protected	Not protected

PROFESSOR'S NOTE

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

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

FIXED-INCOME MANDATES

LOS 22.b: Describe how fixed-income mandates may be classified and compare features of the mandates.

CFA® Program Curriculum, Volume 4, page 11

PROFESSOR'S NOTE

This LOS is a brief introduction to topics to be covered in depth in later readings. Read it and move on. You will see more details of these techniques as you continue in fixed income.

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

- **Cash-flow matching** is the simplest form of immunization. The assets are selected so that cash flows occur when and in the size needed to meet the liability payouts.
- **Duration matching** matches the duration of the assets and liabilities so the two will fluctuate at the same percentage rate as interest rates change, such that their ending values will remain matched.
- **Contingent immunization** (CI) is a hybrid of active management and immunization. The portfolio is initially funded with more money than required to meet the future liability payouts. The present value of the assets (PVA) exceeds the present value of the liabilities (PVL). The difference is the surplus. As long as the surplus is positive, the portfolio can be managed in any way the manager believes will add value. If CI succeeds, the surplus will grow and the ultimate cost of CI will be less than that of initially immunizing. If the active management is unsuccessful and the surplus declines to zero, the portfolio must be immediately immunized and the ultimate cost of CI will be more than that of initial immunization but by a known amount.
- **Horizon matching** is another hybrid approach, combining cash-flow and duration matching to fund multiple future liabilities. Shorter-term liabilities are cash-flow matched, and longer-term liabilities are duration matched. Cash-flow matching is more restrictive in the assets that can be used but safer as it provides more certainty the funds will be there. Duration matching is more complex and somewhat riskier but gives the manager more flexibility in asset selection; that flexibility is likely to lead to an ability to find assets with higher yield and therefore to require a smaller initial investment to meet the future liabilities. Therefore, the horizon matching should cost less than pure cash-flow matching, with minimal additional risk.

Figure 22.2: Comparison of Liability-Based Strategies

	Initial funding required (PVA)	**Risk and complexity**	**Expected realized return if successful**
Cash-flow matching	(3)	Lowest (1)	Lowest (1)

Horizon matching	(2)	(2)	(2)
Duration matching	Lowest (1)	(3)	(3)
Contingent immunization	Highest (4)*	Highest (4)	Highest (4)

* This reflects the requirement to initially overfund with a surplus.

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

- **Pure indexing,** which attempts to replicate the performance of a bond index. It targets zero active return and risk. Unlike the equity market, the large number of individual bonds in most indexes and their potential lack of liquidity makes literal duplication of the index (holding every issue in the same weight as in the index) impractical. Most pure bond indexing instead seeks to exactly match all the risk factors of the index (such as duration, credit or quality, sectors, and prepayment risks) while still allowing the manager some leeway on the individual bonds selected. The turnover (trading) in the portfolio should be low and similar to the turnover in the index.

指数增强

- **Enhanced indexing** allows some additional flexibility in constructing the portfolio and seeks to add some modest active return (perhaps 20 to 30 bps with active risk below 50 bps). Typically, duration (interest rate risk) is still matched to the index, but some risk mismatches such as modest over- or underweighting of sectors and quality are allowed. Somewhat higher portfolio turnover is likely.
- **Active management** allows much larger deviations from the risk factors of the index and seeks greater active return (perhaps +50 bps). Duration can also be mismatched and portfolio turnover can be much higher.

BOND LIQUIDITY

LOS 22.c: Describe bond market liquidity, including the differences among market sub-sectors, and discuss the effect of liquidity on fixed-income portfolio management.

CFA® Program Curriculum, Volume 4, page 19

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

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

PROFESSOR'S NOTE

Some authors refer to an illiquidity premium and others to a liquidity premium. They mean the same thing. The current Level III fixed-income readings call it a liquidity premium, meaning extra compensation in the form of higher yield for lack of liquidity. Remember that as liquidity and the ability to execute transactions at reasonable prices decrease, the liquidity (or illiquidity) premium and yield increase.

Liquidity varies widely by bond market subsector. Generally:

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

Effects of Liquidity on Bond Portfolio Management

- *Pricing data*. Historically bonds trade over the counter with past price and value information not reported. This makes it difficult to find pricing information. Some countries have moved towards centralized collection and reporting of this trade information, increasing market transparency. In the absence of such reporting or with infrequent trading of a bond issue, pricing information may be based on out-of-date trade prices. Instead of using old prices, bond pricing is often based on **matrix pricing**. Information is gathered on recent trades of bonds with similar features (maturity, quality, and coupon). The YTM of those trades is used to calculate the inferred market price of similar bonds. The presence of prepay features such as a call option makes finding appropriate YTM information more difficult, or such features may have been ignored, making the inferred price less accurate.

- *Portfolio construction*. Buy-and-hold investors have less need for liquidity as they have no plans to sell the bonds; thus, they may prefer to select less liquid bonds in exchange for higher yield. In contrast, active investors and traders will prefer more liquid bonds, reasoning their active management strategies will generate addition return and compensate for lower initial yield. Other investors who anticipate the possibility of needing to sell bonds before maturity to meet unexpected needs may tend to avoid less liquid bonds such as longer maturity and smaller issuers or private placements.
- The fact that most bond trading is done in dealer markets leads less liquid bonds to trade at higher bid-asked spreads. Dealers will reason that if they purchase such bonds, it will take longer to then resell them. Thus, dealers will widen the bid-ask to earn greater expected compensation for holding less liquid bonds in inventory.

Alternatives to Direct Investment in Bonds

PROFESSOR'S NOTE

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

- Derivatives include bond futures and interest rate swaps. Futures are exchange traded, and interest rate swaps are over-the-counter. But in many countries, there have been changes to require margin posting, centralized swap settlement, and posted bid-ask pricing; all of which make the swap market more like an exchange-traded market.
- Exchange-traded funds (ETFs) are available and replicate many sectors of the fixed-income market. The shares are easily traded and have high liquidity. Qualified institutions may conduct arbitrage between the underlying assets in the ETF and the ETF shares. This provides a mechanism that keeps ETF share price closely linked with the price of the underlying assets, benefiting all users of the ETFs.

MODULE QUIZ 22.1

To best evaluate your performance, enter your quiz answers online.

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

2. A fixed-income portfolio manager is seeking to outperform the Barclays Capital Aggregate Bond Index. Which of the following statements *most accurately* describes a pure indexing strategy for achieving the total-return mandate? Pure bond indexing:
   A. allows large deviations from the risk factors of the index and seeks a high active return.
   B. matches duration to the index, but some risk mismatches of sectors and quality are allowed.
   C. seeks to exactly match all the risk factors of the index while allowing the manager some leeway on the individual bonds selected.
3. Regarding the varying liquidity characteristics among bond market subsectors, which of the following bond issues would typically lead to higher levels of liquidity?
   A. Issuing a small corporate bond issue.
   B. Issuing on-the-run sovereign government debt.
   C. Issuing a corporate bond that is below investment grade.

MODULE 22.2: MODELING RETURN

LOS 22.d: Describe and interpret a model for fixed-income returns.

CFA® Program Curriculum, Volume 4, page 23

Video covering this content is available online.

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

EXAMPLE: Expected return of a bond portfolio

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

Par value (notional principal) in millions	50
Average coupon rate of portfolio	3.0%
Coupon frequency	Semiannual
Horizon analysis	1 year
Average bond price of portfolio	101.500
Projected bond price in one year if yield curve is unchanged	102.419
Average bond convexity (C) of portfolio	28

Average bond duration (modified duration or MD) of portfolio	5.60
Expected average yield and spread change of portfolio (ΔY)	–0.54%
Expected credit losses	0.06%
Expected gains or losses versus investor's currency	+1.57%

Projected return:

Component 1, **income yield**:

Annual coupon payment / current bond portfolio price = 3.0 / 101.50 = 2.956%.

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

This could be converted to a periodic return for periods other than a year. Over 6 months it would be 2.956 / 2 = 1.478%. It would also be possible to assume a reinvestment rate on the cash flows. For example, if the average coupons were assumed to be paid semiannually with the first payment in 6 months and a 2% reinvestment rate, then ½ of 3% will be collected in 6 months and reinvested for 6 more months at 1% periodic rate (2% reinvestment / 2). That would provide another 1.5 × 0.01 = 0.015% of return. Note that such additional assumptions are less likely and distract from the basic analysis.

Component 2, **rolldown return**:

This is a bond pricing model projection of the bond prices in the portfolio assuming the yield curve is unchanged. For example, suppose the portfolio were made up only of a seven-year bond priced to yield 2.76% with a price of 101.50. Further assume the initial yield curve is upward sloping and the six-year bond yields 2.56%. A bond pricing model could be used to project the price of the seven-year bond in one year when it is a six-year bond priced at a 2.56% yield. (Note that this is not necessarily a simple analysis for a portfolio of bonds and would have to be done bond by bond and then aggregated. That is why it is a given value in the data provided). The rolldown return is the bond's:

(end of horizon period projected price − beginning price) / beginning price

= (102.419 − 101.50) / 101.50 = 0.905%

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

Components 1 and 2 are sometimes combined and called the **rolling yield**: 2.956 + 0.905 = 3.86%.

Also be aware that it is common to use the terms *yield* and *return* interchangeably. If it matters, there will be sufficient context to determine what is meant.

Component 3, **expected price change** based on the investor's expected change in yield and spread:

Let's assume the projected price based on rolldown of 102.419 is in fact an aggregate portfolio yield (YTM) of 2.56%. The analyst then projects a general decline in interest rates of 50 basis points and a decline in credit spreads as well. Weighting the credit spread decline for the portion of the portfolio in credit-risky bonds with the general 50 basis point decline, she projects a 54 basis point overall decline versus the 2.56% yield used in the rolldown calculation. Expected price change is calculated from the investor's expected change in yield and spreads using the portfolio's duration and convexity:

deltaP/P= - D*deltaY + 1/2*deltaY^2

^ ^

$(–MD \times \Delta Y) + (½C \times \Delta Y2) = (–5.6 \times –0.0054) + (½ \times 28 \times 0.00542) = 0.03024 + 0.00041 =$ 3.065%

Notice that the convexity effect is very small and only adds 0.041% to the return. Convexity is a second order effect and often insignificant for option-free bonds unless the ΔY is very large. If the portfolio includes bonds with embedded option, then option adjusted D and C (also called effective D and C) must be used instead of modified D and C. Floating-rate securities would also complicate the analysis as their price sensitivity and D to a general change in rates is low (near 0), but they are sensitive to changes in spread.

Component 4, **credit losses**: EL=DP*LGD

Estimate probability of default times expected loss severity. For example, the analyst estimates 0.071% of the portfolio's bond value will default and 15% of any defaulting value will be recovered, which means 85% of defaulting bond value will be lost, making the expected credit losses 0.071% × 0.85 = 0.060%.

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

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

Projected bond return is the sum of:

1. Yield income: Annual coupon amount / current bond price

   3.0 / 101.50 = 2.956%
2. Rolldown return: (projected ending bond price (BP) − beginning BP) / beginning BP; based on no change in the yield curve

   (102.419 – 101.50) / 101.50 = 0.905%
3. Price change due to investor yield change predictions: $(–MD \times \Delta Y) + (½C \times \Delta Y2)$

   $(–5.6 \times (–0.0054)) + (½ \times 28 \times 0.0054^2) = 3.065\%$
4. Less credit losses: predicted default adjusted for recover rate

   0.071% × 0.85 = –0.060%
5. Currency G/L: projected change in value of foreign currencies weighted for exposure to the currency

   3.925% × 0.40 = 1.570%

   = expected total return for the year = 8.395%

   Rolling yield = #1 + #2

And rolling yield = 2.956 + 0.905 = 3.86%.

Except for yield income, this analysis is based on projections. Rolldown assumes the yield curve is unchanged. But techniques for plotting the yield curve vary. Plotting is often done using on-the-run government bond yields and then the curve is interpolated between those points. At times, the curve may be based on off-the-run government bond yields. Such bonds are more numerous, but the yields usually include a liquidity premium. Predicted price change is based on only duration and convexity projection. It does not include how individual bonds may shift in relative valuation. Credit losses and currency G/L are pure predictions.

MODULE 22.3: LEVERAGE AND TAX ISSUES

LOS 22.e: Discuss the use of leverage, alternative methods for leveraging, and risks that leverage creates in fixed-income

portfolios.

Video covering this content is available online.

CFA® Program Curriculum, Volume 4, page 27

Leverage is a way to increase portfolio return and is particularly attractive in periods of lower interest rates (and expected return). (The return on the portfolio can also be called the return on investor's investment or equity in the portfolio.) As long as funds can be borrowed (B) at rates below the return earned on the investments made ($r_I > r_B$), leverage will enhance portfolio return. Leverage also increases the exposure of the portfolio to interest rate risk and loses if interest rates increase above the return on portfolio assets ($r_I < r_B$). Borrowing is normally done at shorter-term interest rates, and those costs can increase faster than return on assets if interest rates increase. Said another way, the asset duration normally exceeds the liability duration in a leveraged portfolio.

The leveraged portfolio's return (return on investor equity) can be calculated as:

r_p = portfolio return (amount) / portfolio equity

$r_I + [(V_B / V_E) \times (r_I - r_B)]$

where:

r_p = return on portfolio

r_I = return on invested assets

r_B = rate paid on borrowings

V_B = amount of leverage

V_E = amount of equity invested

There are multiple ways to achieve leverage.

Repurchase agreements (repos) are an explicit way to borrow funds that could be used for leveraging. A securities owner "sells" a security for cash and simultaneously agrees to "buy" it back at a specified future date. The repo is functionally a way to borrow money, and the assets are the collateral for the loan. The loan term is often overnight, though the repo could be renegotiated the next day at a new interest rate. Longer repo terms are also possible. The borrowing nature of the transaction is even more evident in the details of the transaction. A securities dealer might enter an overnight \$100,000,000 repo at a 2.5% repo rate. This means the dealer receives 100,000,000 and pays back 100,000,000 × [1 + (0.025 / 360)] the next day. (This is the normal calculation methodology for repo rates.)

The actual securities "sold" are not typically specified, and the money borrower can deliver any types previously agreed to. This is called general collateral. For example, any domestic government bonds can be delivered, and their market value must equal 102% of the repo amount, in this case \$102 million. The 2% is a haircut amount and provides additional security to the money lender. The lender now holds collateral worth more than the funds lent. The collateral is returned the next day (for an overnight repo) when the loan is repaid. Other kinds of collateral can also be allowed to secure the loan, and the haircut would be larger for riskier and less liquid securities. In other words, the repo rate may not need to be adjusted based on the quality of the collateral because the amount of collateral is adjusted.

The repo can be bilateral with cash and collateral securities directly exchanged between the two counterparties or tri-party. Tri-party repos use an intermediate third party (usually a bank) who holds the underlying collateral for the two counterparties and records the exchange of ownership. That is less costly than actually exchanging ownership between the two counterparties.

The above repo is cash driven and any collateral (previously agreed to by the parties to the repo) can be used. Repos can also be security driven. In a security driven repo, the money lender wants to have temporary possession of specific collateral. They may need it for some hedging or arbitrage reason and could offer a lower repo rate in exchange for delivery of a specific security. The repo is now a form of securities lending (and will be discussed later).

Futures contracts also provide leverage. Futures contracts can be purchased and require only a small initial margin deposit. The contract price times multiplier is the full price of the contract and the quantity of the underlying security now controlled. In other words, buying a bond contract at a full price of $105,607 requires only a small margin deposit but provides the upside and downside of buying that full amount of underlying bonds. The amount of leverage achieved can be calculated as:

leverage = (notional value of contract − margin amount) / margin amount

Swap agreements also provide leverage. Entering a 10,000,000 notional 5-year receive 4% fixed versus pay LIBOR swap is equivalent to buying 10,000,000 of 5-year 4% bonds and borrowing 10,000,000 at a floating rate of LIBOR. A receive-fixed swap increases the portfolio's exposure to the bond market and its duration with no explicit investment of funds. A receive-floating versus pay-fixed swap would have the opposite effect. Traditionally, swaps did not require posting of collateral and were largely unregulated and unreported; the 2008–09 financial crisis has led many swap users to settle swaps through a central clearinghouse, providing some of the benefits of standardization and exchange trading.

Structured finance instruments can also provide leverage. An inverse floater is one such product. Consider buying at par a GBP10 million 6-year (20% − (4 × LIBOR)) floater. This is equivalent to buying GBP50 million at par of a 4% 6-year bond and borrowing GBP40 million at a floating rate of LIBOR.

PROFESSOR'S NOTE

The reasoning and calculations behind this are not covered in or needed for the CFA program. You can see that GBP50 million of asset exposure is created with GBP40 million of borrowing and GBP10 million of investor capital. That creates the net coupon exposure of 5 × 4% = 20% less 4 × LIBOR paid, all for the same GBP10 million investment in the floater. This area of financial engineering is interesting, and you are welcome to explore it after the exam. Google would provide a number of relevant discussions.

Securities lending, as mentioned earlier, is closely related to the repo market, but the motivations are different. Securities lending often supports short-selling. Short-selling means selling a security that is not owned and receiving immediate payment for the security. In many cases, the security must be immediately delivered, so the short seller must borrow the security from someone else (and later return the security). A bilateral repo can be used to do this. The securities borrower specifies the desired security or securities to be received. The lender of the securities will specify the amount and types of collateral that the securities lender will receive back.

The lender of the securities can specify receiving cash in exchange for the securities lent. The securities lender can then invest the cash (which is typically greater than the value of the securities lent) to earn interest and compensation. The securities lender could also agree to accept back general, high-quality government bonds as collateral. Suppose the securities lender lends 10 million of a specific bond and receives back 10.5 million of various government bonds in exchange. The securities lender earns the interest on that collateral. If those earnings are higher than the fair compensation for the securities lent, a portion might be rebated to the securities borrower. The rebate rate equals:

Rebate rate = collateral earnings rate − security lending rate

PROFESSOR'S NOTE

Think of it as I need 50 million of bond X, you have it and will lend it to me if I compensate you. You will take back as collateral some larger amount (say 105%) of cash or general (not specific) government securities. You can use that collateral to find another way to make some money, and if I really need bond X could induce me to pay you other explicit fees. Obviously, this is a very specialized market used by a small number of large participants.

Unlike the repo market, security lending agreements are usually open ended. They do not have a specified maturity and continue until one counterparty requires settlement, reversing the transaction with return of the collateral. This can create additional risk if the other counterparty was not prepared to reverse his part of the transaction.

Ultimately, the earnings of the securities lender depend on how badly the securities borrower needs that specific collateral. If the need is high, the securities lender can demand an explicit fee. The securities lender can also demand more cash be posted as collateral or require more general collateral to be delivered. Either increases what the securities lender can earn.

Risks Created by Leverage

In addition to the obvious risk, if the costs of borrowing increase above the earnings on the portfolio assets, other risks are also created. If interest rates increase, the value of the leveraged portfolio and collateral will decline. This may induce money lenders to demand repayment and force liquidation of portfolio assets when they are down in value. This is referred to as a fire sale, selling under distressed conditions. If such liquidations are widespread, they can produce a vicious cycle as each round of sales drives down prices, leading other credit providers, repurchase participants, and securities lenders to demand repayment and/or stop lending.

MANAGING TAXABLE AND TAX-EXEMPT PORTFOLIOS

LOS 22.f: Discuss differences in managing fixed-income portfolios for taxable and tax exempt investors.

CFA® Program Curriculum, Volume 4, page 32

Both tax-exempt and taxable investors should seek the highest possible risk-adjusted return net of fees and transaction costs, consistent with their objectives and constraints. This is more complex for taxable investors because taxes must also be taken into account to determine after-tax return and risk. Different types of tax issues arise and differ by tax jurisdiction around the world. The following are some examples:

- The two sources of bond return are usually taxed differently. Income may be taxed at a different rate from capital gains (price change). Both are usually taxed only when realized, but there are exceptions. For zero coupon bonds, imputed income (increase towards par) may be taxed each year as income even though there is no cash flow.
- In general, capital gains are only taxed at sale and at a lower tax rate than for interest income. Gains on securities held for a longer period may be taxed at a lower rate than on securities held for a shorter period.
- Capital losses may only be allowed to be used to offset capital gains, but not other income sources. But if capital losses exceed gains, they may be carried forward to offset future realized gains. (In some cases, the realized losses can be carried back to reduce taxes already paid for a previous year, generating a tax reduction or refund on the current tax return.)
- It may be possible to invest some portions of the portfolio in tax-sheltered or tax-advantaged accounts.

Strategies to use in managing taxable accounts include:

- Realize capital losses to offset gains. This can include selective tax loss harvesting for partial sales when the investment was acquired at multiple prices.
- Extend holding periods to realize long-term, rather than short-term, capital gains.
- Extend holding periods to defer taxes.
- Consider differentials in income versus gain tax rates when selecting investments.

PROFESSOR'S NOTE

The above is just a listing of issues from earlier readings. Review the earlier material if it seems unfamiliar.

Taxation of investments in mutual funds and other collective investment funds varies by country. Income on the underlying assets is usually taxable to the fund investors when it is earned by the fund, regardless of whether the income is paid out or reinvested in the fund. However, the taxation of gains realized within the fund varies.

- Some countries use pass-through taxation of gains. The fund investor is taxed when the fund realizes the gain and that tax payment subsequently reduces taxes on gains when the investor sells the fund shares.

- Other countries use deferred taxation of the gains realized within the fund and instead tax the investor on all gains when the fund shares are sold.

In contrast, when a client hires a manager to manage the client's portfolio directly (a separately managed account) all income, gains, and losses in the portfolio are normally reported on the client's tax return and taxable to the client.

EXAMPLE: Taxable vs. tax-exempt portfolios

A manager must raise EUR5,000,000 to meet a client's need for funds. The client's portfolio is separately managed, and all tax issues are passed through and immediately taxable to the client. Income and capital gains tax rates are 38% and 15%, respectively. The manager is looking at two bonds and will sell all of one or of the other. Both have market value of EUR5,000,000 and have the same remaining maturity, coupon, and credit quality. Any taxes owed due to the sale are to be ignored in the analysis and covered by other client funds. Bond A has a significant unrealized gain, while bond B has a significant unrealized loss. The manager believes the bonds are substantially identical except bond B has a slightly higher yield.

Select the bond the manager will sell and **explain** why if the investor is 1) taxable, or 2) tax-exempt.

Answer:

1. Taxable: Sell bond B to avoid realizing a gain and paying a tax now.
2. Tax-exempt: Sell bond A to retain bond B and its slightly better yield.

MODULE QUIZ 22.2, 22.3

To best evaluate your performance, enter your quiz answers online.

1. Suppose that a bond portfolio has 25 million in notional principal. It has an average coupon rate of 5% and pays coupons on a semiannual basis. The average bond duration of the portfolio is computed as 8 and the average convexity of the portfolio is 0.5. If an investor in this portfolio expects the average yield and spread change of the portfolio to be 0.35%, the expected portfolio price change due to her forecast is *closest* to:
   A. –1.752%.
   B. –2.799%.
   C. –3.978%.

   dP/P=-duration*dY+1/2*C*dY^2=-8*.35%+0.5*0.5*.35%^2
2. A credit investor is interested in using leverage in his portfolio to enhance return. Which of the following statements is *most correct* regarding the use of leverage and the risks that leverage creates when implemented in fixed-income portfolios?
   A. If interest rates increase, the value of the leveraged portfolio and collateral decline.
   B. Liability duration normally exceeds asset duration.
   C. As long as funds can be borrowed at rates above the return earned on the investments made, leverage will enhance portfolio return.
3. When managing fixed-income portfolios for taxable investors, which of the following strategies should *most likely* be applied?
   A. Realize capital gains to offset any losses.
   B. Shorten holding periods to realize long-term, rather than short-term, capital gains.
   C. Consider differentials in income versus gain tax rates when selecting investments.

KEY CONCEPTS

LOS 22.a

- Provide portfolio diversification with generally low correlation to equity.
- Provide regular cash flow.
- Floating-rate and inflation-indexed bonds provide forms of inflation protection.

LOS 22.b

Liability-based mandates dedicate portfolio assets and reinvest future cash flows to fund future liabilities:

- Cash-flow matching funds liabilities with coupon and par amounts received on the dates the liabilities are paid.
- Duration matching (immunization) matches asset and liability duration to achieve comparable results. Both are forms of immunization. Duration matching generally gives more flexibility in asset selection and therefore may meet the objective at a lower cost.
- Horizon matching is a hybrid of cash-flow matching nearer term liabilities and duration matching the longer-term liabilities.
- Contingent immunization is a hybrid of active management with potential immunization. The portfolio must initially be overfunded and can be actively managed. If successful (unsuccessful), the surplus will grow (be lost) and the ultimate cost will end up being lower (higher) than from immunization.

Total return mandates typically seek to match or exceed the return of a benchmark index:

- Pure indexing exactly matches the holdings of the index.
- Enhanced indexing allows modest deviations (but matches duration to control interest rate risk).
- Active management does not restrict deviations versus the index.

LOS 22.c

Liquidity in the bond market (ability to buy or sell on a timely basis at or near fair market value) is substantially lower than in equity markets.

- Most bonds do not trade or trade infrequently after issuance.
- The sheer number and variety of individual bond issues is immense.
- The market is mostly over-the-counter with trade price and volume not reported.
- Liquidity is highest for sovereign government, higher-quality, and most recently issued (on-the-run) bonds.
- Smaller issues are generally less liquid.

Effects:

- Bond pricing data is more difficult to obtain.
- Portfolio managers have to choose between more liquid bonds or less liquid bonds that may offer a liquidity premium.
- Derivatives and ETFs are generally more liquid and an alternative to direct investment in bonds.

LOS 22.d

Return can be projected (or actual return decomposed) as the sum of:

1. Yield income: annual coupon amount / current bond price
2. Rolldown return, assuming no change in yield curve: (projected ending bond price (BP) − beginning BP) / beginning BP
3. Price change due to investor yield change predictions: $(-MD \times \Delta Y) + (\frac{1}{2}C \times \Delta Y^2)$
4. Less credit losses: predicted default adjusted for recover rate
5. Currency G/L: projected change in value of foreign currencies weighted for exposure to the currency

Yield income + rolldown return may be referred to as rolling yield.

LOS 22.e

- Leveraged portfolio return can be calculated as $r_I + [(V_B / V_E) \times (r_I - r_B)]$.
- If r_I exceeds (is below) r_B, the leverage enhances (reduces) portfolio return.
- Repurchase agreements (and securities lending), futures contracts, swaps, and structured investments can all be used to leverage return.
- In addition to the detrimental effects if r_I is less than r_B, the lender of the funds can demand repayment, forcing liquidation of portfolio assets at fire sale prices, which can feed a financial crisis.

LOS 22.f

Taxes complicate portfolio management as managers seeking to maximize return must consider the different tax effects of each portfolio decision.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 22.1

1. **B** Inflation-linked bonds provide direct protection for the effects of inflation. They protect coupon payments from inflation and adjust par (i.e., principal) for inflation. Floating-coupon securities also provide protection from change in inflation, but the adjustment mechanism is different and only affects the coupon. Fixed-coupon bonds do not protect coupons or principal from the effects of inflation. (LOS 22.a)

2. **C** Pure indexing attempts to replicate the performance of a bond index. It seeks to exactly match all of the risk factors of the index while still allowing the manager some leeway on the individual bonds selected. Enhanced indexing allows some additional flexibility in constructing the portfolio and seeks to add some modest active return. Active management allows much larger deviations from the risk factors of the index and seeks greater active return. (LOS 22.b)

3. **B** Liquidity for on-the-run high-quality sovereign government debt is high and declines somewhat for older off-the-run issues. These government bonds are usually large in size and have a high level of credit quality. Liquidity among corporate bonds typically declines with lower quality as the bonds become riskier and with the size of the issue (i.e., smaller issuers are less liquid). (LOS 22.c)

Module Quiz 22.2, 22.3

1. **B** Expected price change is calculated from the investor's expected change in yield and spreads using the portfolio's duration and convexity as follows: $(–MD \times Y) + (½C \times Y^2) = (–8 \times 0.0035) + (½ \times 0.5 \times 0.0035^2) = –0.028 + 0.000003 = –2.7997\%$

   (Module 22.2, LOS 22.d)

2. **A** If interest rates increase, the value of the leveraged portfolio and collateral decline. As long as funds can be borrowed at rates *below* the return earned on the investments made, leverage will enhance portfolio return. Asset duration normally *exceeds* the liability duration in a leveraged portfolio. The other statements are false because a typical leverage transaction involves borrowing at lower shorter-term rates (and therefore in a liability with low duration) to invest at longer-term higher rates (and therefore in an asset with higher duration). (Module 22.2, LOS 22.d)

3. **C** Strategies to use when managing taxable accounts include:
   - Realize capital *losses* to offset *gains*.
   - *Extend* holding periods to realize long-term, rather than short-term, capital gains.

- Consider differentials in income versus gain tax rates when selecting investments.(Module 22.3, LOS 22.f)

The following is a review of the Fixed-Income Portfolio Management (1) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #23.

READING 23: LIABILITY-DRIVEN AND INDEX-BASED STRATEGIES

Study Session 11

EXAM FOCUS

We now turn to the substantive discussion of liability-based and index-based fixed-income management approaches.

MODULE 23.1: LDI, BASICS

LOS 23.a: Describe liability-driven investing.

CFA® Program Curriculum, Volume 4, page 46

Video covering this content is available online.

Broadly speaking, **liability-driven investing** (LDI) is used when there are definable future liabilities to be paid from portfolio assets. It is classified as passive total return, but in this context, that does not mean nothing should be done—as many of these strategies require continual monitoring and adjustments. (In contrast, active management generally means managing to outperform a specified index or benchmark.) The specific LDI approach used depends on the nature of the liabilities. LDI is mostly used for institutional portfolios. There are some commonly used terms:

- **Asset-liability management** (ALM) means strategies that consider assets in relation to liabilities. It is appropriate when both the present value (PV) of the assets and liabilities change with changing interest rates.
- **Liability-driven investing** (LDI) or liability-based investing takes the liabilities as a given and manages the assets to meet those future liability values—for example, there is an insurance company or defined benefit (DB) pension plan that must fund future liability payouts. (Note that LDI is now being used in a more specific way than in the initial paragraph. The focus of this reading is on this more specific type of LDI investing, where the liabilities are taken as a given and the assets are managed in relation to those liabilities.)
- **Asset-driven investing** (ADI) takes the assets as a given and manages or adjusts the liabilities in relation to those assets. For example, a leasing company with specific types of floating- or fixed-rate financial assets may structure its liabilities to match the characteristics of those assets.

LDI can also apply to individuals, particularly when the goal is to accumulate sufficient funds to meet retirement. Consider a married individual who plans to retire in 12 years and is planning to use the value of his bond portfolio to fund the purchase of an annuity. He will reinvest any cash flows from the bonds and could also plan to add a regular amount to the bond position every year to meet the goal.

Four types of liabilities exist:

1. **Known future amount(s) and payout dates(s), called Type I**. The issuer of an option-free fixed-rate bond has this type of liability. We will see that these are the easiest type of liability to model.
2. **Known future amount(s) but uncertain payout dates(s), called Type II**. The issuer of a callable or putable bond has this type of liability. An insurance company selling term life insurance also fits here. The amount of payout is known, but the date of payout on any single policy is not. (However, actuaries can apply the law of large numbers to estimate likely payout amounts in any given period with considerable accuracy.)
3. **Uncertain future amount(s) but known payout dates(s), called Type III**. Floatingrate instruments and real rate bonds such as Treasury Inflation Protection Securities (TIPS) fall in this category.
4. **Uncertain future amount(s) and uncertain payout dates(s), called Type IV**. Property and casualty as well as some DB plan liabilities fall in this category.

Simple duration (Macaulay or modified) is adequate to model Type I liabilities. The others require effective duration—modeled to reflect the initial shape of the yield curve plus assumed upward and downward shifts in the yield curve to estimate the potential amount and timing of liability payouts.

IMMUNIZING A SINGLE LIABILITY

LOS 23.b: Evaluate strategies for managing a single liability.

CFA® Program Curriculum, Volume 4, page 50

Immunization is a fixed-income management process in which the portfolio is managed to minimize the variability of the rate of return earned over a specified time period. That means the future value (FV) of the portfolio can be confidently predicted, and if enough funds are invested initially, a known future liability can be funded.

Cash flow matching is the simplest but least flexible approach to immunizing. For a single liability, buy a zero-coupon bond with par and maturity matching the liability. With no cash flows to reinvest or bonds to sell, there is no cash flow or price risk. The bonds must also be default free.

Because a single liability is effectively a zero-coupon liability, its time to payment is also its Macaulay duration. Thus, a cash flow matched immunized portfolio will match the Macaulay durations of the assets and liabilities.

Macaulay duration is the weighted average time until the cash flows of an instrument are received. That is why Macaulay duration of a zero-coupon instrument is its maturity, but Macaulay duration of a non-zero-coupon instrument is less than its maturity. The weights are based on each cash flow's PV as a percentage of the total PV of the instrument's cash flows (the latter being the price of the instrument).

Macaulay duration is also a balance point where price and reinvestment risk offset each other:

- **Price risk** is the uncertainty of proceeds if a bond must be sold before maturity.
- **Reinvestment risk** is the uncertain FV of any cash flows received and reinvested before the end of the holding period.

If it is assumed interest rates change only once, immediately, in parallel fashion, and by a small amount, then:

- If rates increase, higher earnings from reinvesting all cash flows will offset a loss on price at the end of the horizon period.
- If rates decrease, lower earnings from reinvesting all cash flows will offset a gain on price at the end of the horizon period.

The unreasonable nature of the assumptions will be dealt with soon.

Modified duration is Macaulay duration divided by 1 plus the periodic interest rate used to compute the cash flow PVs: Mod D = Mac D/(1+y)

- Modified duration is the (slightly) more accurate measure of immediate price change of the instrument.
- Macaulay duration is the (slightly) more appropriate measure of time for some immunization techniques.

Computing portfolio statistics: Portfolio yield (meaning YTM), duration, ??? dispersion of cash flows, and convexity are commonly computed as weighted averages based on market value weighting of each holding in the portfolio. **For ALM, these average computations are less accurate than portfolio statistics computed directly from the portfolio's aggregate cash flows.**

PROFESSOR'S NOTE

There is no LOS or indication that you should try and make these portfolio statistic calculations. They are provided, and your challenge is to understand how to apply them in immunization situations. The actual process would require access to computer spreadsheet tools. The process is summarized here for those interested.

1. Project the time to receipt (starting with the nearest to most distant) of every portfolio cash flow.
2. Determine the aggregate portfolio cash flow in each period. The analysis uses six-month periods.
3. Determine the portfolio IRR that equates future cash flows with the current market value of the portfolio.
4. Use that IRR to determine the PV of each future cash flow from step 2. (The sum of those PVs will be the current portfolio market value.)
5. Calculate the PV weight (w) to apply to each payment as its PV (step 4) divided by the sum of the PVs.
6. For each cash flow, multiply its *(w)* by its time until receipt *(t)*. The sum of the *(w)(t)*s is the portfolio's Macaulay duration. Duration is normally expressed in years, so if the cash flow periods were in six-month increments, divide by 2 (two six-month periods in a year) for annual duration.

7. Portfolio dispersion is computed as the weighted average variance of when each cash flow is received around portfolio duration. (Remember, duration is just the weighted average of when all the cash flows are received).
8. Portfolio convexity can be computed by summing for each cash flow: *[(t)(t + 1)(w)]* and then divide this sum by $(1 + \text{portfolio } IRR_{\text{periodic}})2$.

Here is what to focus on:

Portfolio statistics should be used for ALM work rather than traditional weighted average calculations based on each bond. The difference in the two approaches is determined by the shape of the yield curve:

- With a flat yield curve, there is no difference.
- In an upward-sloping yield curve, portfolio duration and IRR will be higher-than-average duration and YTM of the bonds because portfolio statistics reflect all cash flows (and return) to be received and the longer maturity bonds will impact the portfolio for a longer time.
- (Downward sloping curves are unusual and not discussed. In such a situation, you would build a spreadsheet and calculate all the numbers to see what happens. You cannot make such spreadsheet calculations on the exam.)

The goal of the immunized portfolio is to earn the initial portfolio IRR, not the average YTM of the bonds. Earning the IRR means the portfolio will grow to a sufficient FV to fund the liability.

PROFESSOR'S NOTE

Although we have just made the point that portfolio-level statistics based on aggregate portfolio cash flow and IRR should be used, be aware that it is not unusual to use simple weighted average date (such as YTM and duration) as approximations. That would add some error to the analysis.

The dispersion will be important because it is related to convexity and the convexity effect. Convexity matters because, when combined with modified duration, it provides a more accurate measure of estimated price change. Recall that %Δ in value = $(-MD\ \Delta Y) + (\tfrac{1}{2}C\ \Delta Y2)$.

But more specifically, in relation to immunization:

$$\text{convexity} = \frac{\text{Macaulay duration}^2 + \text{Macaulay duration} + \text{dispersion}}{(1 + \text{periodic IRR})^2}$$

The dispersion and convexity will indicate the risk exposure of the immunization strategy to structural risk from shifts and twists in the yield curve.

EFFECTS OF YIELD CURVE CHANGES

Assume that the portfolio is being used to immunize a single liability (sometimes called a bullet) due in five years, the portfolio and liability D are initially matched at the 5.0 medium (M) duration of the liability, the initial value of the portfolio equals the discounted (at portfolio IRR) PV of the liability, and portfolio convexity exceeds convexity of the single cash flow liability. We can create an extreme situation to demonstrate the issues. Assume that the portfolio is made up of two bonds with a shorter (S) and longer (L) duration than the liability duration (M). This describes a barbell portfolio strategy, concentrating the assets in longer and shorter duration around the liability's single (bullet) duration.

If the yield curve shifts up or down in parallel fashion, the portfolio results will slightly exceed the amount required to pay the future liability. Duration matching alone would have led to meeting the future liability need, but the additional positive convexity of the assets will lead them to outperform duration results alone for large parallel shifts in the curve. (Recall the dispersion of cash flows and thus the convexity of the two-bond portfolio must exceed that of the single-point liability.)

- For a large parallel increase in the curve (Figure 23.1), the immediate decrease in portfolio value will be less than the decrease in the PVL due to the positive convexity effect. With the parallel increase, the new portfolio IRR will increase by basically the same amount as the increase in discount rate for the PVL. In other words, the future rate of increase in A and L are still the same, but starting from a new PVA that is relatively higher than the PVL, the FVA will exceed the FVL.
- For a large parallel decrease in the curve (Figure 23.2), the immediate increase in portfolio value will exceed the increase in the PVL due to the positive convexity effect. With the parallel decrease, the new portfolio IRR will decrease by basically the same amount as the decrease in discount rate for the PVL. In other words, the future rate of increase in A and L are still the same, but starting from a new PVA that is relatively higher than the new PVL, the FVA will exceed the FVL.

Figure 23.1: Parallel Yield Shift Up

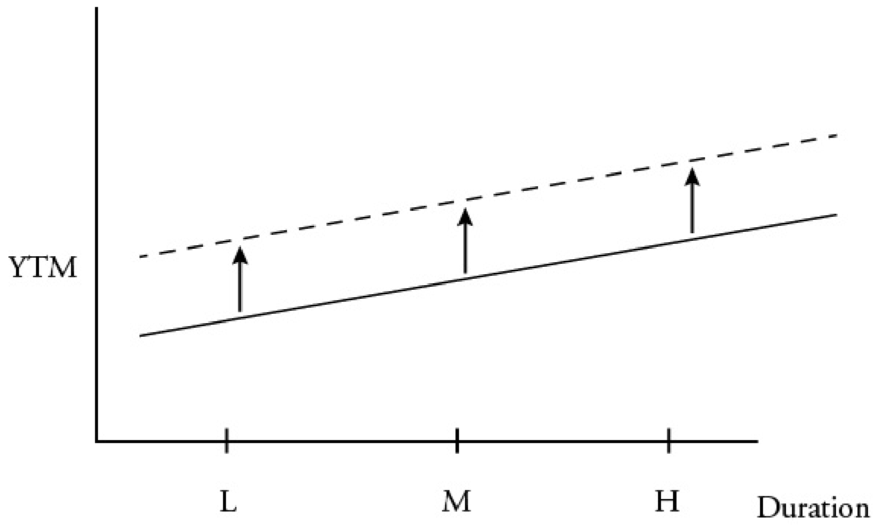
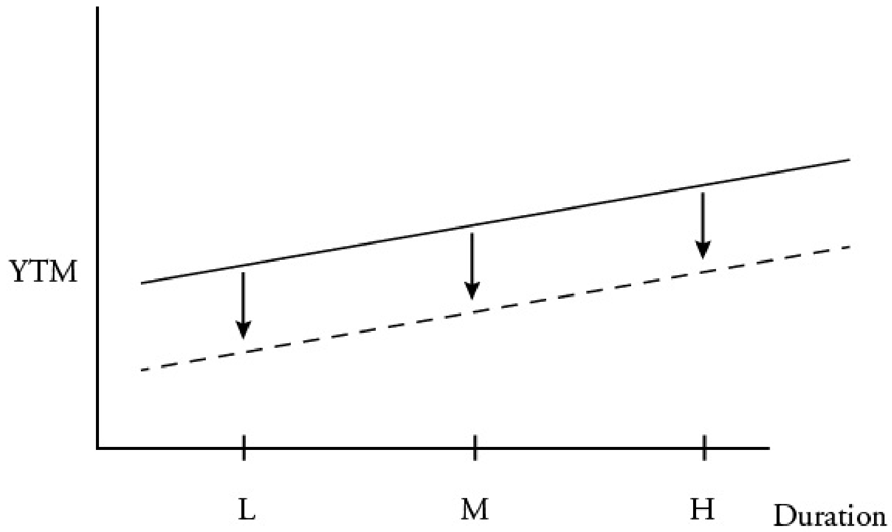


Figure 23.2: Parallel Yield Shift Down



The parallel shift analysis indicates that the duration (rather than cash flow) matching immunization strategy does have **structural risk**. The structural risk is due to creating portfolio duration with a different allocation of asset durations (L and H) versus the allocation of liability durations (M only). That can lead to differing performance of the assets and liabilities as the yield curve shifts. Fortunately, most interest rate changes can be described as roughly parallel, and by building the portfolio with an asset dispersion (hence, convexity) that exceeds the single liability payout date, the portfolio benefits from the structural risk.

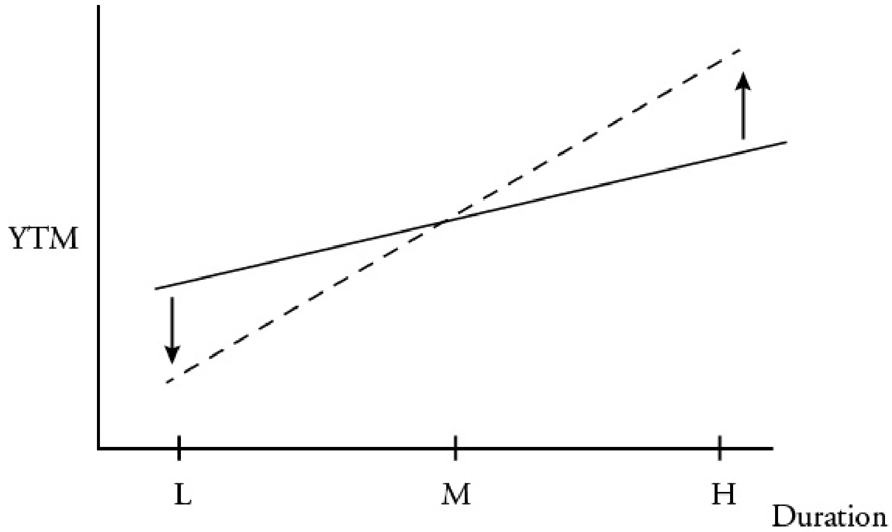
The parallel shift analysis:

- Indicates that immunization can be described as *zero replication*. A single zero-coupon bond could have been used for a no-risk, perfect cash flow match. The changes in portfolio value and IRR have replicated (or done better due to positive convexity) the changes in yield and value of that replicating zero-coupon bond. In general, if the change in portfolio IRR matches change in yield of the replicating zero, the risks for the strategy are low.
- Does not indicate the strategy is always structurally risk free. Other kinds of yield curve reshaping may or may not cause the strategy to fail in meeting the future payout. These other reshapings are discussed shortly.
- Does indicate the parallel shift assumption is sufficient to lead the strategy to succeed—but it is not a necessary assumption because the strategy may still be successful in other conditions. 充分，非必要 It is *sufficient*, but not *necessary*.
- Does not mean the strategy is buy and hold. Coupon-bearing bond duration declines more slowly than maturity, while the bullet liability duration will decline linearly with the approaching pay date. To maintain the immunization, the portfolio assets must be continually rebalanced to continually match portfolio to liability duration as time or market conditions change; otherwise, the strategy is at risk.

If the curve either steepens or flattens, the analysis becomes more complex and the structural risk increases. Assume for this discussion that rates do not change for the M duration liability, but move in roughly opposite directions for the L and H duration assets.

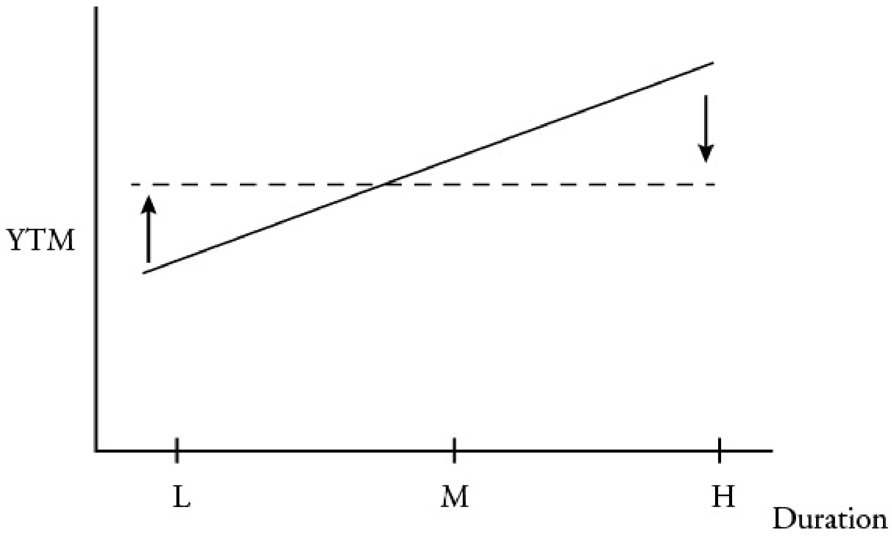
- Steepening twist (Figure 23.3): Yield L decreases while yield H increase relative to yield M. The portfolio market value will decrease because the decline in value of the longer duration bond will exceed the increase in the value of the shorter duration bond. PVL will be unchanged with no change in yield M. PVA is now below PVL. That, by itself, does not indicate the strategy will fail. If portfolio IRR increases sufficiently, the required FV might still be reached. (Recall that portfolio IRR would tend to increase above a single point M YTM with a steeper curve). This indicates that a steepening curve may create structural risk.

Figure 23.3: Steepening Twist



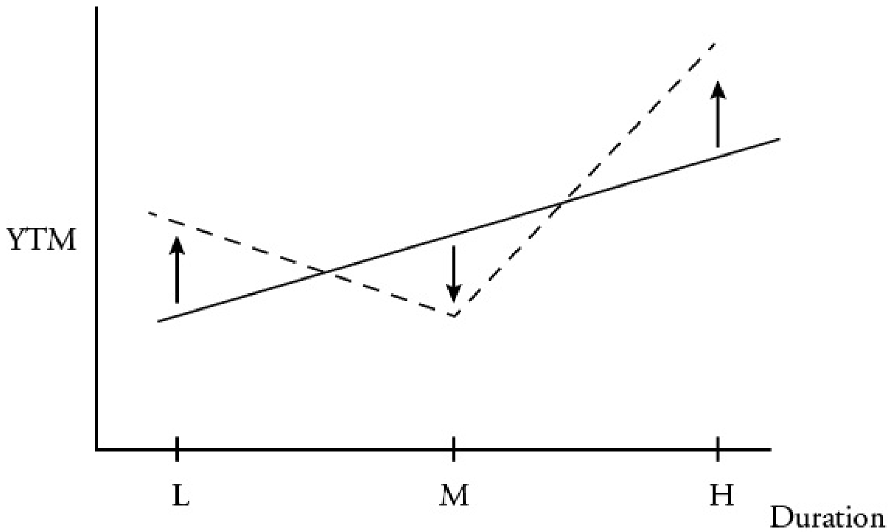
- Flattening twist (Figure 23.4): Yield L increases while yield H decrease relative to yield M. The portfolio market value will increase because the increase in value of the longer duration bond will exceed the decrease in the value of the shorter duration bond. PVL will be unchanged with no change in yield M. PVA is now above PVL. That, by itself, does not indicate the strategy will succeed. If portfolio IRR decreases sufficiently, the required FV of assets to meet the payout may not be reached. (Recall that portfolio IRR would tend to decrease below a single point M YTM with a flatter curve). This indicates that a flattening curve may create structural risk.

Figure 23.4: Flattening Twist



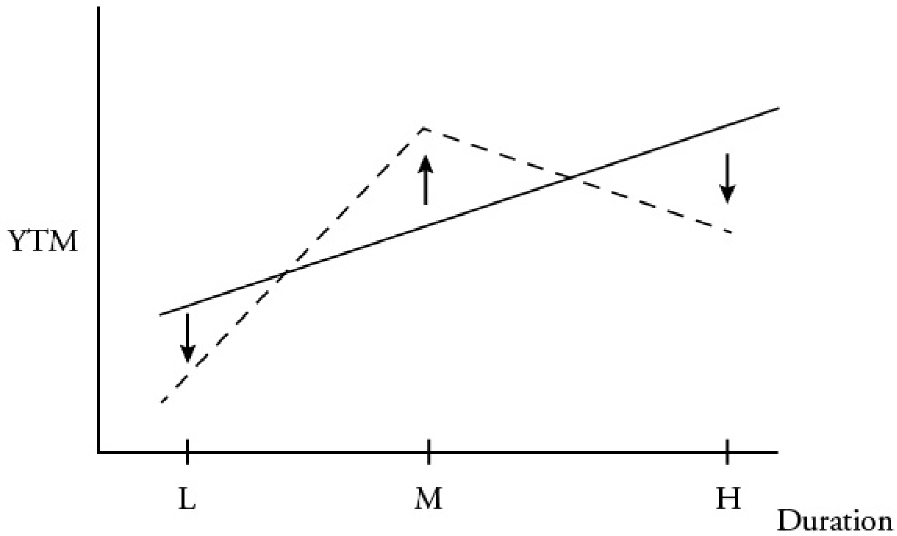
- Positive butterfly twist ([Figure 23.5]): Yield L and H increase while yield M decreases. The portfolio market value will decrease as both yield L and H increase. PVL will increase as yield M decreases. PVA is now below PVL. That is certainly detrimental, but it is possible the strategy could succeed if the portfolio IRR increases enough versus the decrease in liability discount rate. This indicates that the positive butterfly may create significant structural risk.

Figure 23.5: Positive Butterfly Twist



- Negative butterfly twist ([Figure 23.6]): Yield L and H decrease while yield M increases. The portfolio market value will increase as both yield L and H decrease. PVL will decrease as yield M increases. PVA is now clearly above PVL. That is certainly favorable, but does not guarantee the strategy will succeed if the portfolio IRR decreases too much in relation to the increase in liability discount rate. It again indicates the possibility of significant structural risk.

Figure 23.6: Negative Butterfly Twist



The risk in immunization is higher when the change in portfolio IRR does not match the change in yield of the replicating zero or is insufficient to fund the liability at the new level of rates. This structural risk can be reduced by reducing the dispersion of asset cash flows around the liability cash flow. This is not surprising because if you make dispersion 0, you have a zero-coupon bond and a perfect cash flow match to the single liability. Now, recall the earlier equation for determining convexity from duration and dispersion; reducing dispersion is directly related to reducing convexity. This leads to the rules for immunizing a single liability:

1. Initial portfolio market value (PVA) equals (or exceeds) PVL. (There are exceptions to this for more complex situations where the initial portfolio IRR differs from the initial discount rate of the liability.)
2. Portfolio Macaulay duration matches the due date of the liability ($D = D_L$).
3. Minimize portfolio convexity (to minimize dispersion of asset cash flows around the liability and reduce risk to curve reshaping).
4. Regularly rebalance the portfolio to maintain the duration match as time and yields change. (But also consider the tradeoff between higher transaction costs from more frequent rebalancing versus the risk of allowing durations to drift apart.)

PROFESSOR'S NOTE

It may seem strange to require minimizing convexity of assets when +C is good for immediate price change. But that ignores the real issue of immunization, failing to reach the FV needed to pay the liability.

Money duration: The first two conditions of immunization can be combined by matching money duration of the assets and liability. Money duration is the money change in value of the assets or liability for change in interest rates. It can be calculated as modified duration (MD) multiplied by the value of the item multiplied by a specified change in yield of the item. It is common to express it as **basis point value** (BPV):

$$BPV = MD \times V \times 0.0001 = \text{Price Value of a Basis Point}$$

BPV is also referred to as *price value of a basis point* (PVBP) or value of an 01, meaning a 1 BP change in rates.

IMMUNIZING MULTIPLE LIABILITIES

LOS 23.c: Compare strategies for a single liability and for multiple liabilities, including alternative means of implementation.

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Cash flow matching is the safest approach. In some cases, this may allow *accounting* 废除？ *defeasance* where the assets are legally set aside and dedicated to meet the labilities—allowing both those assets and liabilities to be removed from the balance sheet of the organization responsible for paying the liability. The simplest cash flow match is to buy zero-coupon bonds in the amounts and due dates to meet each liability.

- Cash flow matching of a stream of liabilities may also be possible using coupon-bearing bonds. In concept, a bond is purchased due on and with par plus (+) final coupon to exactly fund the longest liability. Its earlier coupon payments can be used to partially meet the earlier liabilities. Then, in recursive fashion, the next-longest liability is funded by buying a bond due on and with par plus (+) final coupon to exactly fund that next-longest liability (after considering the coupon of the bond or bonds already purchased for the longer liability or liabilities).
- In practical terms, it is unlikely that the coupon-bearing bonds necessary for perfect cash flow matching will exist. A *cash-in-advance* constraint could be used, requiring the bond used to fund a specific liability to mature before the required payout date of the liability. This would expose the portfolio to reinvestment risk in an upward-sloping yield curve. The upward-sloping curve is anticipated to create reinvestment risk because as cash comes in to be reinvested for a short time period until payout, the reinvestment must be at the lower rates at the short end of the curve.

Duration matching is a more flexible and generally practical approach to funding multiple liabilities. Like immunizing a single liability, there must be sufficient assets to fund the liability, and Macaulay durations of assets and liabilities (in this case, the average liability duration) must match. However, matching money durations is the more common approach. Money duration is more useful when initial amounts and discount rates of assets and liabilities differ. The rules for immunizing multiple liabilities become the following:

1. Initial portfolio market value (PVA) equals (or exceeds) PVL. (There are exceptions to this for some situations where the initial portfolio IRR differs from the initial discount rate of the liability.)
2. Portfolio and liability basis point values match ($BPV_P = BPV_L$)
3. Asset dispersion of cash flows and convexity exceed those of the liabilities. (But More convexity but not too more not by too much, in order to minimize structural risk exposure to curve reshaping).
4. Regularly rebalance the portfolio to maintain the BPV match of A and L as time and yields change.

EXAMPLE: **U.K. Bond Company**

1 A U.K.-based company has several option-free bond issues (liabilities) outstanding. The company would like to retire the bonds early, and has more than sufficient funds to do so. The company considers a bond tender offer (offer to repurchase the bonds from the public), but the bonds are widely distributed among buy and hold investors. The prices that would have to be paid are too high to make the tender desirable to the company.

The company could also establish a dedicated 2 cash flow matched portfolio of U.K. government bonds and legally defease the bonds. In that case, both the company's bond liabilities and assets (the cash flow matching bond portfolio) could be removed from the company's balance sheet. The cost of the portfolio would be GBP475 million, and the company considers this too high.

The third alternative is to establish a 3 duration matching portfolio; using high-quality corporate bonds, the cost will be less than for the government bond portfolio. While the portfolio will not qualify for defeasance, the company believes it will improve its credit rating and is the better choice.

The portfolio statistics for the company's liabilities and three proposed corporate bond portfolios are shown in the following table. All calculations are annualized and based on aggregate portfolio cash flows. Each portfolio is considered sufficient to pay the liabilities. Monetary amounts are in GBP:

Statistics	**Company's Liabilities**	**Proposed Portfolios**		
		A	**B**	**C**
Market value	457,780,900	Approximately 460,000,000		
Modified D	7.52	7.51	7.53	7.37
BPV	344,250	343,100	345,400	339,120
Convexity	45.12	35.14	46.29	65.97

1. **Select** the most appropriate portfolio (A, B, or C) to immunize the liabilities and **justify** your selection with *two* reasons.
2. If the company expects high volatility and the potential for very large parallel shifts in the yield curve, **select** the *one* other portfolio (A, B, or C) it would most likely consider and **explain** why.

Answers:

1. Portfolio B—because (1) its BPV closely matches, and (2) its convexity slightly exceeds that of the liabilities.
2. Portfolio C—while the BPV is not as good a match, it has much higher convexity, and this would increase return relative to change in liability values for large parallel shifts in the yield curve.

MODULE 23.2: MANAGING A DURATION GAP

A **derivatives overlay** can be used to adjust the portfolio and maintain the duration match without the expense of adjusting the underlying assets. Futures contracts are often used.

Video covering this content is available online.

In the United States, there are various Treasury futures contracts available based on the 30-year bond, as well as 2-, 5-, and 10-year Treasury notes. Each contract specifies a set of deliverable securities that the contract seller may deliver at contract expiration. The seller must deliver 100,000 par of a deliverable security [also called *most deliverable bond* or *cheapest to deliver* (CTD) bond]. The buyer must pay the seller the initial contract price multiplied by the conversion factor for that bond (CF_{CTD}) that the seller chooses to deliver. In recent years, an Ultra 10-year contract was developed that specifies a much narrower range of deliverable notes. The purpose of this was to limit the deliverable items to ones that have a duration much closer to that of the 10-year note. The issue of which bond the seller chooses to deliver is important because the duration of that CTD determines the duration (price volatility) of the contract—hence, its BPV. The exact calculation of contract BPV is complex (not covered by CFA material), but is approximately:

$$\text{futures BPV} \approx \frac{BPV_{CTD}}{CF_{CTD}}$$

Calculating the number of contracts required to adjust the portfolio assets is simply the desired change in BPV divided by the BPV of the contract:

$$N_f = \frac{\text{BPV of liability} - \text{BPV of current portfolio}}{\text{BPV of futures}}$$

EXAMPLE: U.K. Bond Company Revised

Suppose the U.K.-based company seeking to immunize its bond liabilities had instead chosen to immunize only a portion of its debt. The company selected an asset portfolio with a BPV of 217,525 to immunize a portion of the liabilities with a BPV of 217,512—a duration gap of only 13. After a modest increase in rates with a significant positive butterfly twist, the asset and liability BPVs are now 203,456 and 218,517 for a duration gap of 15,061.

Assume that there are government bond–based futures contracts based on 5- and 10-year notes, with features similar to U.S. Treasury–based futures contracts. Each contract specifies a range of deliverable government notes that the contract seller may select for delivery at contract expiration. Each deliverable note requires the seller to deliver 100,000 par and the buyer to pay initial contract price multiplied by the conversion factor for that bond (CF_{CTD}).

Figure 23.7: Characteristics of the CTD Note for the 5- and 10-Year Contracts; Per 100,000 Par

CTD Characteristics	5-Year Contract	10-Year Contract
YTM	1.71%	2.51%
Modified D	4.75	8.67
BPV of CTD	48.1650	86.7001
Conversion factor	0.9237	0.9169

1. **Determine** and **justify** if contracts will be bought or sold, assuming:
    a. the 5-year contract is used.
    b. the 10-year contract is used.
2. **Calculate** contracts to use, assuming:
    a. the 5-year contract is used.
    b. the 10-year contract is used.
3. If the liability duration is 8.99, **state** which contract is most likely to minimize structural risk based only on the information provided. You must choose either the 5 or 10 year, and not a

combination of both. **Justify** your answer.

Answers:

1. To increase asset BPV to match liability BPV, buy contracts regardless of which contract is used.
2.
   a. Contract BPV ≈ 48.1650 / 0.9237 = 52.1436 (218,517 − 203,456) / 52.1436 = buy 289 contracts
   b. Contract BPV ≈ 86.7001 / 0.9169 = 94.5579 (218,517 − 203,456) / 94.5579 = buy 159 contracts
3. The only available, relevant information is the liability duration. The 10-year contract is the better duration match. This closer match would likely minimize structural risk to nonparallel yield curve shifts.

PROFESSOR'S NOTE

You should be noticing that the PVA = PVL requirement is a bit of a misstatement. It will be true initially if the portfolio yield and liability discount rate are equal. Even then, it need not hold true after initiation, as the path of portfolio yield and liability discount rate can diverge. The strategy can still succeed if the changes in portfolio market value and yield track the path an immunizing, replicating zero-coupon bond could have followed. In other words, if the change in portfolio market value reflects a new portfolio yield, that will still reach the FVL desired. But even at initiation, PVA need not equal PVL if the portfolio yield and liability discount rate differ.

In practice, initially overfunding the portfolio with more market value than the strictly require PVA is common. If the surplus is significant, contingent immunization can be considered.

Contingent immunization (CI) is a hybrid active/passive strategy and requires a significant surplus. As long as that surplus is of sufficient size, the portfolio can be actively managed. At the extreme, assets could be invested in equity, commodities, real estate, or any other assets. If the assets earn more than the initially available immunization rate, the surplus will grow, and can eventually be returned to the investor. If the strategy is unsuccessful, the surplus will shrink, and the portfolio must be immunized before the surplus declines below zero. For example:

- Invest the entire portfolio in stocks.
- Invest only the surplus in stocks or in long stock options. Use the balance of the assets to construct an immunized portfolio. This approach allows fewer funds for active management, but is in some ways safer because only the surplus amount is at risk of loss, and an immunized portfolio is already in place.
- Use active bond management techniques. Returning to the previous U.K. example that required buying 159 of the 10-year note contracts, the manager could overhedge or underhedge based on a view of interest rates. Consider the 159 contracts to be a 100% hedge.
  - If the manager believes rates will increase, underhedge (<100%) and the losses on the contracts will be reduced, improving portfolio performance and increasing the surplus.
  - If the manager believes rates will decrease, overhedge (>100%) and the gains on the contracts will be increased, improving portfolio performance

and increasing the surplus.

- Because the contract is based on 100,000 par, each 1/32 of change in price of 100 par will equate directly to a gain or loss on the contract of 31.25 [(1 / 32) × (100,000 / 100)].

CI approaches can be vulnerable to liquidity risk.

- If all of the assets (instead of just the surplus) are actively managed and the surplus declines, the assets must be quickly liquidated without further loss and converted to an immunizing portfolio before the surplus becomes negative.
- Even if only the surplus amount is actively managed, liquidity issues can still be a problem. If short option contracts were used, the downside risk is unlimited for calls and very large for puts (in excess of initial premiums received). Likewise, the potential losses on futures contracts are very large and could exceed the portfolio surplus.

MODULE QUIZ 23.1, 23.2

To best evaluate your performance, enter your quiz answers online.

1. A bond issuer is reviewing the four main categories of liabilities. He is interested in issuing a liability that can be managed easily and has known future amounts and payout dates. Which of the following types of liabilities *most likely* meets the issuer's demands?
   A. Callable bonds.
   B. Option-free fixed-rate bonds.
   C. Treasury inflation-protected securities.
2. An investor is looking to immunize a single liability, but is concerned with the impact from yield curve shifts and twists. When attempting to immunize this liability, which of the following rules should the investor apply?
   A. The portfolio Macaulay duration should match the due date of the liability.
   B. The dispersion of asset cash flows around the liability should be maximized.
   C. The present value of liabilities should exceed the initial portfolio market value.
3. Which of the following statements correctly describes contingent immunization?
   A. It uses Treasury futures contracts to adjust the portfolio and maintain duration matching.
   B. It constructs a portfolio of zero-coupon bonds that provide enough cash inflows to meet liabilities.
   C. It uses active bond portfolio management, as long as the present value of assets exceeds the present value of liabilities.

MODULE 23.3: ADVANCED STRATEGIES

Pension funds can include complex Type IV liabilities where both the amount and timing of payouts may be uncertain.

Video covering this content is available online.

PROFESSOR'S NOTE

We include a brief description of the complexities of projecting these liabilities. There is no direct LOS or questions for that issue. I suggest you briefly skim this note and move to the discussion of the various LDI strategies and issues.

Pension plan rules normally base benefit payouts on years of service, wages, and some multiplier. LDI strategies require estimates of those liabilities. Actuaries can develop models to estimate those liabilities based on the following: initial years of service by employees to the company (G), current wage rate (W_0), wage growth rate and future wages (w and W_T), the multiplier (m), additional years of work until retirement (T), a discount rate (r) related to risk (a high-quality corporate bond rate is normally used), and an estimate of how many years the benefit will be paid (Z).

The liability projection can then be based on the accumulated benefit obligation (ABO), which is a lower number and represents the legal liability if the plan were closed now or a higher projected benefit obligation (PBO) of what is actually expected to be paid in an ongoing plan. Unless the plan is terminating, the higher PBO is generally the more realistic number.

The risk characteristics of the liability must also be estimated. This is normally done by assuming equal upward and downward shifts in the yield curve (Δcurve) to generate a lower PV_+ of the liabilities if rates move up, and higher PV_- if rates move down around the initial PV_0 of the liabilities. Such data can then be used to infer effective duration (and convexity, though that formula is not covered).

$$\text{effective D} = \frac{PV_- - PV_+}{2 \times \Delta\text{curve} \times PV_0}$$

More complex analysis may be needed to incorporate changing yield curve shape and path dependency issues such as effect on interest rate levels and time to retirement.

Typically, it is assumed there is no reliable, consistent relationship between other portfolio assets such as equity in the portfolio and interest rates. Their value may be affected by changing interest rates, but not in the same predictable way as fixed-income assets. In such cases, the duration of those other plan assets is assumed to be zero.

LOS 23.d: Evaluate liability-based strategies under various interest rate scenarios and select a strategy to achieve a portfolio's objectives.

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As an example, assume an ongoing DB pension plan has a PBO of USD2.57 billion. The effective duration has been modeled as 9.35. The BPV of the liabilities is:

2.57 billion × 9.35 × 0.0001 = 2,402,950 BPV_L

The plan assets of $3.07 billion are 60% equity and 40% bonds. The manager chooses to hold a laddered bond portfolio of 1-to-5-year Treasury and investment grade corporate bonds; his reasoning is that these can be used to fund nearer-term plan distributions. While there is no cash flow match, the bonds are highly liquid and can be sold to meet distributions. The duration of the bonds is only 2.85. The BPV of the assets is:

3.07 billion × 0.40 × 2.85 × 0.0001 = 349,980 BPV_A

The duration gap is 2,402,950 − 349,980 = 2,052,970. The manager reasons he can use the Treasury bond contracts to eliminate the duration gap. The contract is based on

100,000 par. The CTD bond has a BPV of 128.98, duration of 13.53, and a conversion factor of 0.9436. The BPV of the contract is:

$128.98 / 0.9436 = 136.6893 \text{ BPV}_{\text{futures}}$

Assuming the manager has no view on interest rates, he could construct a 100% hedge to remove the duration gap. He will buy contracts to increase the asset duration:

$$N_f \text{ for } \overset{100\%}{\cancel{110\%}} \text{ hedge} = \frac{2,402,950 - 349,980}{136.6893} = 15,019 \text{to buy}$$

Assume instead that the manager has discretion to overhedge or underhedge by 10%, and he believes that interest rates will decline. To profit by this, he will buy more contracts than required for a 100% hedge to set the asset duration above the liability duration. He will buy:

N_f for 110% hedge = 1.10 × 15,019 = 16,521 to buy

Now, assume instead that the manager believes that interest rates will increase. To profit by this, he will buy fewer contracts than required for a 100% hedge to set the asset duration below the liability duration. He would have bought:

N_f for 90% hedge = 0.90 × 15,019 = 13,517 to buy

Hedging with futures creates operational and practical risks. Margin must be posted and adjusted daily; that means all gains or losses on the contracts are posted in cash (or other securities) daily. Recall that each 1/32 change in price of the contract is a gain or loss on each contract of 31.25. If the hedge is successful, that G/L is an offset to changes in the value of the liability. But those are changes in unrealized value, not cash flow that must be posted in the margin account. In practice, these issues make 100% hedges rare in such situations. Partial hedges (< 100%) to reduce the duration gap are more common.

PROFESSOR'S NOTE

While not needed (and requiring data not provided in the discussion), the 1/32 value change of 31.25 per contract on an assumed starting par price and duration of 13.53 can be used to infer the change in rates needed to cause that percentage change in price: 31.25 / 100,000 = – dP/P=-D*dY 13.53 Δr, making the Δr only about 0.2 basis points. Clearly, the margin cash flow issues can be substantial on some 15,000 contracts with even modest changes in rates.

Interest rate swaps are another way to adjust the duration gap. As OTC instruments, they may avoid the margin cash flow issues of futures. Recall that a receive-fixed swap is equivalent to buying more bond assets and will increase portfolio duration; it has positive (+) duration. A pay-fixed swap will reduce duration; it has negative (−) duration. The swap's net duration is calculated as the difference between fixed- and floating-rate bonds that would replicate the swap's future coupon flows.

Assume a 10-year swap is available and the manager has discretion to hedge 30%–70% of the duration gap, with a 50% hedge considered a neutral or normal position. The duration gap in BPV is still 2,402,950 − 349,980 = 2,052,970 with asset duration too low. The duration of the replicating fixed and floating sides of the swap are 9.18 and 0.25. The BPVs per 100 notional for each side of the net swap duration are:

receive fixed-side BPV = 100 × 9.18 × 0.0001 = 0.0918 receive floating-side BPV = 100 × 0.25 × 0.0001 = 0.0025

net swap BPV = +0.0918 − 0.0025 = 0.0893

The notional swap principal (NP) required to close the duration gap for a 100% hedge is the duration gap in BPV divided by the swap BPV per 1 NP. Note that the BPVs are per 100 NP and must be divided by 100 for BPV per 1 NP.

Enter a receive-fixed swap to increase asset duration:

$$\text{NP} = \frac{2,052,970}{(0.0893/100)} = 2.3\text{billion for a } 100\% \text{ hedge}$$

Assuming the manager expects rates to increase and given the hedging constraints, what hedge would be used?

With increasing rates expected the manager will leave asset duration as low as permitted for a 30% hedge. He will enter a receive-fixed swap of 0.3 × 2.30 = 0.69 billion NP.

Assuming the manager just entered the 30% hedge and now believes rates will decline, what will he do?

He will want to increase asset duration to the max allowed, a 70% hedge. He would want a receive-fixed swap of 0.7 × 2.30 = 1.61 billion NP. That will require an additional receive-fixed swap of 1.61 − 0.69 = 0.92 billion NP.

While historically swaps have not required margin posting, that has been an evolving issue. Many swaps now require periodic marking to market and posting of the gain or loss in margin or as a direct cash settlement. That reduces counterparty and credit risk, but introduces the same practical cash flow complications of exchange-traded futures.

An alternative to the swap is a swaption. The plan pays an initial premium for the right to enter a swap. The plan that needs to increase BPV of assets would purchase a receiver swaption, giving the plan the *right* to initiate a receive-fixed swap at a prespecified **swap fixed rate** (SFR); the swap's SFR may be called the *swaption strike rate*. The cost is limited to the initial premium paid. As time passes, comparing the SFR for new swaps (new SFR) to the SFR of the swaption determines if the swaption has value:

- If the new SFR declines, this right to receive a now above-market SFR has positive value and effectively increases the BPV of the assets. The value of the swaption is part of portfolio assets and increases the total value of plan assets.
- If the new SFR increases, this right to receive a now below-market SFR has no value, the swaption will not be exercised, and it would be allowed to expire worthless. Note that if a swap had been used instead of a swaption, the plan would suffer escalating losses on a receive-fixed swap.

EXAMPLE: Swap vs. swaption hedges

A U.S. pension plan has a 450,000 BPV duration gap with BPV of assets less than of liabilities. The plan uses a swap with a BPV per 100 notional of 0.2571 to construct a 50% hedge ratio. After setting up the 50% hedge, the manager forms the opinion that rates will increase, and would like to benefit if his view is correct, but be unaffected if he is wrong. The manager would be willing to adjust the hedge position by 15% to a 35% or 65% hedge. He checks and finds that both payer and receiver swaptions are available with a strike rate of 2.7%. The premiums for the payer and receiver swaptions are 55 and 75 basis points, respectively.

1. **State** the terms and **calculate** the notional principal of the 50% hedge ratio swap the manager would use.
2. **State** the terms and **calculate** the initial cost of the swaption the manager would buy or sell to adjust his hedge to a 35% hedge.
3. **Calculate** the rate on new swaps and **state** whether new rates will have to be higher or lower than that rate to make exercising the swaption profitable.

Answers:

1. (450,000 × 0.50) / (0.2571 / 100) = 87.515 million NP of a receive-fixed swap.
2. 15% of the full hedge is (450,000 × 0.15) / (0.2571 / 100) = 26.254 million notional.

   The initial hedge is receive fixed, so to reduce the hedge, the manager will buy a payer fixed swaption of 26.254 million NPl. The premium cost is 26.254 million × 0.0055 = 144,397.
3. If new SFRs are greater than the strike rate of 2.7%, the payer swaption and right to pay 2.7% is valuable and should be exercised.

PROFESSOR'S NOTE

This is hard material. You must know the terminology as well as be able to think clearly and logically to solve these questions.

Regarding Question 1, the assets have less BPV than the liabilities. If rates decline, the assets will increase less than the liabilities, and the plan will suffer. The correct swap is to receive fixed as that will increase duration and BPV of assets to reduce this loss if rates decline.

Regarding Question 2, if the manager wants the right to a smaller hedge position, he needs a pay-fixed swap to reduce his fixed inflow from the initial swap. Buying a payer swaption gives him the right to decide later if he wants to turn on the pay-fixed swap embedded in the swaption.

Regarding Question 3, economic logic dictates that his right to pay 2.7% and receive floating becomes valuable if new market conditions would require paying more than 2.7%. In that case, paying 2.7% is a bargain. The mechanics of how he captures this value are not covered, but there are a couple of possibilities: (1) He can exercise the swaption, pay the bargain SFR, and receive floating in this now higher interest rate environment. Of course, rates as well as the future floating rates received can change. (2) He could exercise the swaption and begin paying the 2.7% plus simultaneously enter into a new receive-fixed swap, receiving an SFR above the 反向swap保证
2.7% he is paying. On each payment date, he will net the difference of 2.7% paid 收益高于2.7%
versus the higher SFR received for the life of the two swaps.

Note that the premium cost paid for the swaption is a sunk cost, and cannot be recovered. It does not affect the decision of whether the swaption is exercised. That premium is paid and gone regardless of whether the swaption is exercised.

The third alternative for the manager who needs to increase asset BPV is a swaption collar, which is a combination of buying one swaption and selling another.

- The manager would buy the receiver swaption to provide economic benefit if the SFR declines.
- To reduce the initial premium cost outlay, the manager sells a payer swaption. Note that this means the buyer of the payer swaption has the right to turn on a pay-fixed swap and the manager (seller) must accept that fixed rate. The buyer will do this if new SFRs exceed the payer swaption's strike rate. The sale of the

payer swaption can limit the potential future benefits to the seller as the buyer will exercise and pay the SFR when rates increase (i.e., when unattractive to the seller of the swaption).

CHOOSING AN OPTIMAL STRATEGY

PROFESSOR'S NOTE

This material requires a solid understanding of terminology, swap diagrams, and the economic rationales of why swaptions are exercised. The discussion of *swaption seller* is tricky. The terms "payer swaption" and "receiver swaption" always refer to the fixed rate action of the *swaption buyer*. The *buyer of the payer swaption* will have positive value if new SFRs exceed the swaption strike rate the buyer would pay. That is negative value to the *seller of the payer swaption*, who must now accept and receive a below-market SFR.

But there is another issue here as well. The purpose of the hedge is to reduce risk. In this case, if rates go down, the assets—with lower BPV than the BPV of the liabilities—will increase in value less than the liabilities. In other words, hedging is to reduce or eliminate interest rate risk, which exists because no one can perfectly predict interest rates. But selecting the optimal hedge strategy will, as we'll see, require at least some ability to predict direction or magnitude of rate changes. Recognize that all three strategies work and reduce interest rate risk. But if you want optimal strategy, you need to predict interest rates to at least some degree.

The choice of optimal strategy will depend on the manager's view of interest rates. Consider the DB plan with a duration gap and a need to increase asset duration. In other words, the plan is currently at risk if interest rates decline because the assets would increase less than the liabilities increase, and the plan surplus would decline. The manager has three swap-based hedging choices:

1. Enter a receive-fixed swap versus pay LIBOR.
2. Buy a receiver swaption.
3. Enter a zero-cost collar composed of buying the receiver swaption and selling a payer swaption.

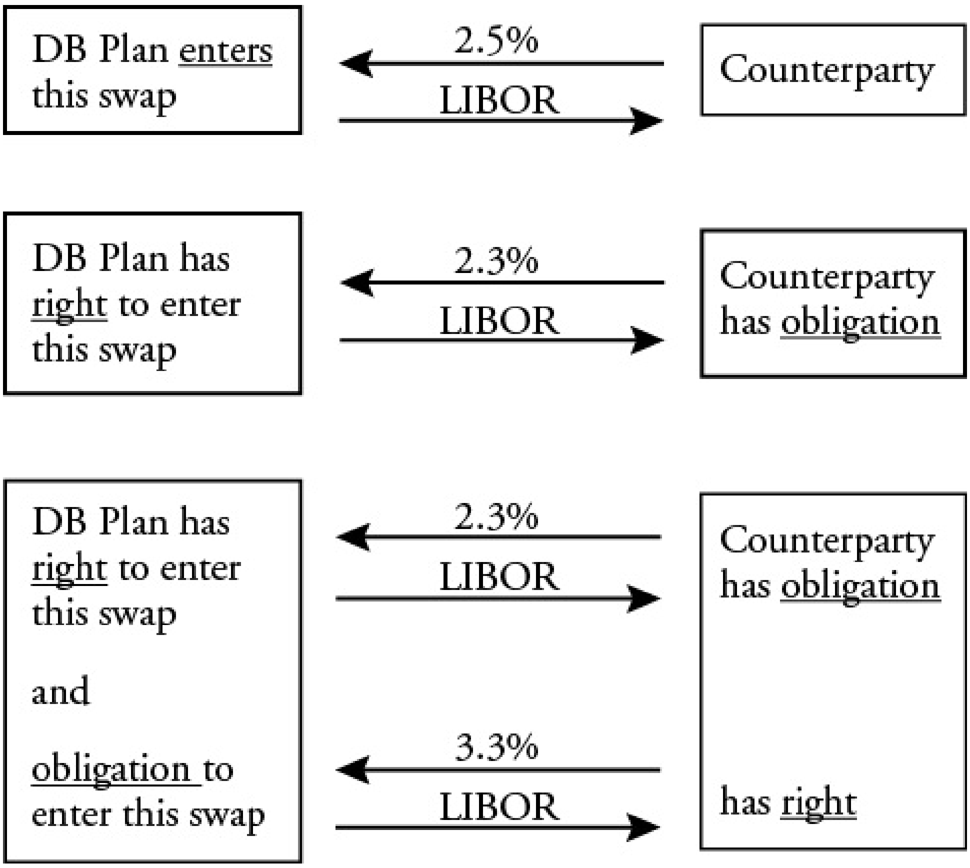
The swap notionals and payment frequency are the same. All floating payments are LIBOR. After consulting with the sponsor and the sponsor's accountants, the manager is instructed that all gain or loss on swaptions will be captured and reported on the sponsor's financial statements. In other words, she can evaluate the swaptions as if they are marketable securities for decision-making purposes. She is directed that she must use one of the hedges because the duration gap is too large and too risky to the plan surplus. All the hedges have the same effect on the duration gap. She cannot be unhedged. She gathers the following additional data:

	Premium Cost
2.5% receive fixed-rate swap	None
2.3% receiver swaption	75 bp
3.3% payer swaption	75 bp

The receive 2.5% SFR swap is optimal if the *manager expects the new SFR will be at or below 2.5%*.

- This is equivalent to buying 2.5% fixed-rate bonds (financed by borrowing at LIBOR), increasing asset duration and BPV. The plan will benefit from the decline in rates.
- Buying the 2.3% receiver swaption is suboptimal because there is an initial cost, and the 2.3% fixed rate received by the plan is lower.
- The collar (buy the 2.3% receiver swaption; sell the 3.3% payer swaption) is suboptimal because the 2.3% fixed rate received by the plan is lower. The payer swaption buyer has no rational reason to exercise his right with the new SFR below 3.3%.

Figure 23.8: Comparing Swap-Related Strategies



The collar is optimal if the *manager expects the new SFR will be above 2.5% but below 3.3%*.

- The collar (buy the 2.3% receiver swaption and sell the 3.3% payer swaption) has no intrinsic value, which is the best choice.
    - The right to receive 2.3% when rates are above 2.5% has no value.
    - The payer swaption buyer has no rational reason to exercise his right with new SFRs below 3.3%.
- The other hedges have negative value or zero value with an up-front cost.

    - The swap of receive 2.5% will have negative value when SFRs are above 2.5%.
    - The receiver swaption (right to receive 2.3%) has no value when new SFRs are above 2.5% and required an initial cost.

Buying the 2.3% receiver swaption is *optimal at some level of new SFRs above 3.3%*.

- The 2.3% receiver swaption has 不执行 no intrinsic value with new SFRs above 3.3%. But there was an initial premium cost. This is the best case at some level of SFRs above 3.3%.
- swap亏钱 The receive 2.5% swap has increasing negative value as new SFRs increase above 3.3%.
- The collar also begins to have increasing negative value as new SFRs increase above 3.3%.
    - The receive 2.3% swaption has no value.
    - 亏钱，对方行权 The 3.3% payer swaption increases in value as SFRs increase above 3.3%, and this is negative value to the seller (the plan).
    - As SFRs increase, that negative value will at some point exceed the initial cost of the receiver swaption, and the receiver swaption would become optimal.
    - collar? The breakeven rate to make the payer swaption optimal is above 3.3%.

PROFESSOR'S NOTE

Fortunately, the method of calculating breakeven above 3.3% is not even covered. We do not plan to respond to requests for, "But I just want to see how to do it."

MODULE 23.4: RISKS

LOS 23.e: Explain risks associated with managing a portfolio against a liability structure.

Video covering this content is available online.

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- Hedge amounts are approximations based on assumed durations and ignore convexity. Convexity matters for large-rate movements.
- Duration assumes parallel shifts in the curve.
- Twists in the yield curve can create substantial structural risk, and immunization may fail to replicate the immunizing zero-coupon bond. Setting asset convexity (somewhat) higher than liability convexity creates net positive convexity (C of assets exceeds C of liabilities) while limiting the dispersion of asset cash flows in relation to liability flows to minimize structural risk.
- Model risk can be significant in some cases. See the earlier discussion of assumptions required to estimate DB plan liabilities, effective duration, and BPV.
- Measurement error when weighted average characteristics of the portfolio assets and liabilities are used instead of portfolio statistics based on portfolio cash flows

and yield (IRR).

- Futures BPV calculations are based on an assumed CTD bond. That bond can change, changing the futures duration and BPV. Also, a more accurate estimate of futures BPV should adjust for accrued interest discounted at short-term rates (because accrued interest paid is recouped 补偿 on the next coupon payment date).
- Portfolio yield and liability discount rate may differ, reflecting different risk levels. This creates spread risk (i.e., the risk the asset and liability discount rates and their PVs may shift in unexpected ways). Here are a few examples.
  - The liability discount rate may reflect corporate debt rates and assets government bond rates. Using Treasury contracts introduces this same potential spread risk.
  - Use of Treasury rates introduces a more subtle risk. The Treasury market is highly liquid and more likely to reflect frequent price change. That is reflected in higher reported volatility of Treasury rates. By definition, *higher volatility* means a higher rate of change in Treasury rates compared to other rates, (i.e., nonparallel shifts).
  - Using swaps also creates spread risk as swap rates directly reflect the LIBOR market.
- Traditionally, OTC derivatives have counterparty risk. The move toward requiring collateral reduces the counterparty risk, but creates cash flow risk. Counterparties must be prepared to meet the demands to post cash or other collateral. The same risks already exist for exchange-traded futures.
- Asset liquidity risk exists if positions cannot be quickly adjusted with reasonable transaction costs.

MODULE QUIZ 23.3, 23.4

To best evaluate your performance, enter your quiz answers online.

1. Assume that the BPV duration gap of a defined benefit pension plan is equal to \$300,000. The pension fund manager would like to hedge 100% of this duration gap with a 10-year swap. The manager finds that the duration of the fixed side of the swap is 8.25 and the duration of the floating side of the swap is 0.5. What is the notional swap principal required to fully close the duration gap?
   A. 125 million.
   B. 387 million.
   C. 495 million.
2. A risk analyst is discussing the risks associated with managing a bond portfolio against a liability structure. She makes three statements regarding liability-driven investment risks. Which of her statements is *most likely* an indicator of spread risk?
   A. "Bond positions cannot be adjusted with reasonable transaction costs in a timely manner."
   B. "Hedge calculations are approximated based on only the duration of the assets and liabilities."
   C. "The liability discount rate may reflect corporate debt rates, and the asset discount rate may reflect government bond yields."

MODULE 23.5: INDEX-BASED INVESTING

LOS 23.f: Discuss bond indexes and the challenges of managing a fixed-income portfolio to mimic the characteristics of a bond index.

Video covering this content is available online.

CFA® Program Curriculum, Volume 4, page 90

Many bond indexes exist—providing varying exposures to duration, credit, and other risk factors. Investing in a bond market index fund provides low cost diversification and an alternative to active fixed-income management. Their goal is to minimize tracking error. Tracking error also called *tracking risk* or *active risk*. It is the standard deviation of the portfolio's active return (portfolio return − benchmark return).

The **pure index** or **full replication approach** requires holding all the securities and weighting them as in the index. **Enhanced indexing** matches all the primary risk exposures of the index, but not all the holdings. The goal is more efficient tracking of the index by avoiding some of the overly costly transactions required for pure indexing.

Indexing for bonds is more difficult than for equity:

- Fixed-income markets are much larger, more bond issues are outstanding, and the characteristics of individual bonds vary widely. This generally makes full replication impractical.
- Any one issuer may have multiple bond issues outstanding. They may differ substantially in liquidity, making it appropriate to concentrate positions in the less-costly to trade, liquid issues.
- Most bond trading is done OTC through dealers, unlike stock traded on exchanges. Capital requirements have increased for dealers post-2008. The higher capital cost has reduced dealers' willingness to hold large bond inventories and increased the bid asked spread charged by dealers. The result is that bond market liquidity has declined.
- Most individual bond issues do not trade in any given year. Many transactions that do occur are not publically reported, making reliable price and volume data more difficult to obtain. This also leads to valuation challenges in existing portfolios. Bond pricing for nontrade securities is based on **matrix** or **evaluated pricing**. The price of similar, traded bonds is captured and used to calculate YTM. That YTM is then used to infer the price of nontraded bonds. The more unusual the features of a bond, the more difficult it is to find an appropriate traded bond to use as the basis of such pricing.
- Bond index composition and characteristics can change fairly quickly as new bonds are issued and old bonds approach maturity or change in credit quality and other characteristics.

Matching the primary risk characteristics of the bond index is generally more practical than full replication. Matching primary risk factors includes:

- Matching modified duration (MD) to minimize tracking error due to parallel shifts in the yield curve. For bonds with embedded options, effective duration must be used instead:

$\%\Delta$ value = $-$MD Δy

- Matching key rate durations to minimize tracking error due to nonparallel changes in the yield curve. There are multiple key rate durations, and each simulates the expected change in value if one single point on the yield curve shifts. For example, the price change if five-year rates shift is as follows:

  $\%\Delta \text{ value} = -MD_{\text{key rate } n}\ \Delta y_n$

- Match weighting exposure to the various bond sector and quality ratings of the index. For nongovernment securities, it is useful to distinguish price change due to a general change in rates (i.e., government bond yields) from spread change. MD measures change due to the general change in rates, and spread duration measures how the nongovernment bonds perform relative to government bonds when (credit) spread changes:

  $MD = \text{Macaulay duration} / (1 + YTM_{\text{periodic}})$

  $\%\Delta \text{ value} = -MD\ \Delta y$

  $\%\Delta \text{ relative value} = -D_S\ \Delta s$

  $\text{spread} = y_{\text{higher yield}} - y_{\text{government}}$

- Matching sector/coupon/maturity cell weights of the index. For example, if the index is 1.7% in A-rated corporates of 2–3 duration, match that weight. When there are bonds with embedded options such as callable or mortgage-backed securities, match these weighting exposures as well. Doing so means effective duration and convexity will be matched.
- Matching issuer exposure weights to control for specific event risk affecting only that issuer, such as bankruptcy.

Another method of minimizing yield curve risk is matching **present value distribution of cash flows**. The following example demonstrates this and its relationship to bond price, duration, and key rate durations. They are all interrelated. The example is for a 4.0% semiannual pay three-year bond trading at par (4% YTM):

4.0% semiannual pay 3-year bond priced at 4% YTM*			**w = PV as % of total PV**	**Duration contribution = (t) (w)**
Cash flow due in time t	**Amount**	**PV**		
0.5	2.00	1.9608	0.0196	0.0098
1	2.00	1.9223	0.0192	0.0192
1.5	2.00	1.8846	0.0188	0.0283
2	2.00	1.8477	0.0185	0.0370
2.5	2.00	1.8115	0.0181	0.0453
3	102.00	90.5731	0.9057	2.7172
		100.0000	**1.0000**	**2.8567**

* for a periodic discount rate of:	2.00%

- List the cash flows by six-month period (t). If there were embedded options, the cash flows would be the best estimates of amount and when the cash would be received.
- The bond's price is the discounted PV of its future cash flows using a 4%/2 semiannual periodic discount rate.
- Each weight (w) is computed as that PV as a percentage of total PV (the price).
- Each (t)(w) is the cash flow's contribution to duration and a key rate duration. The sum of the duration contributions (key rates) is the bond's duration.
- Matching the *w* of portfolio to the *w* of the index will also match their (t)(w). This matching of present value distribution of cash flows is also matching the duration contributions and key rate durations. These actions minimize exposure risk from changes in shape of the yield curve. They also match total duration and convexity.

The goal of matching all the risk factors is to minimize tracking error while avoiding some of the expense of full replication.

ALTERNATIVE METHODS OF OBTAINING PASSIVE BOND MARKET EXPOSURE

Passive index replication provides diversifying exposure to the fixed-income market without the expense of active management. As discussed earlier, the nature of the fixed-income markets generally makes full replication impractical. Enhanced indexing provides one acceptable alternative. **Stratified sampling** (**cell matching**) can be used to implement enhanced indexing. The manager first determines the most significant characteristics that need to be matched. For example, the manager could divide the index into three duration and sector groupings:

Index	**Duration**		
	1–5	**5–10**	**10–15**
Treasury	5.1%		
Corporate			
ABS			

In the cell grid for the index, only the data for 1–5 duration Treasuries is shown. To cell match, the manager will also hold 5.1% in bonds with these characteristics, but need not use all of the same bonds as in the index to do so. The manager will also need to collect and match the weights for the other eight cells.

Cell matching can incorporate **environmental, social, and corporate governance** (ESG) or socially responsible investing restrictions. ESG may prohibit or explicitly require securities with specific characteristics. For example, bonds of high carbon emission industries are prohibited, and bonds of clean energy industries are desired. The manager will seek to do both while still matching cell weights.

Relevant techniques to reduce the expense of pure indexing or add value include:

- Reducing fund expenses, including transaction costs.
- Overweighting undervalued and underweighting overvalued: securities, sectors, and portions of the yield curve; while still matching overall index characteristics. The basic principle is to avoid areas of spread widening and favor areas of spread narrowing.
- Over (under)weighting callable bonds for their typically higher yield, when interest rate volatility is expected to be low (high) and impact of the call feature on price (and effective duration) is more (less) predictable.

LOS 23.g: Compare alternative methods for establishing bond market exposure passively.

CFA® Program Curriculum, Volume 4, page 96

Indirect exposure is an alternative to investing directly in bonds through full or enhanced indexing. Indirect exposure can be gained with funds or synthetically through derivative strategies. These indirect approaches usually avoid the higher initial costs of directly trading in bonds, but incur ongoing expenses and other possible risks.

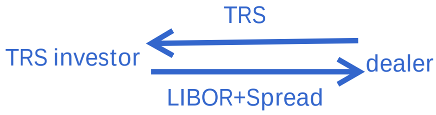
Bond index **mutual funds** may be particularly well suited for smaller investors. They provide broad market exposure with one investment and economies of scale. Aggregating the capital of many investors typically gives these funds access to more securities at better prices.

Open-ended fund shares can be redeemed or purchased at **net asset value** (NAV) once per day. However, such funds charge ongoing management fees and may also charge fees at purchase 申购 (front load) or sale 赎回 (back load). Unlike bonds, they do not typically mature, plus the holdings and income stream change over time.

Exchange-traded funds (ETFs) provide some advantages in that the shares trade continuously on exchanges and investors can buy or sell continuously, rather than once per day. The typical investor cannot purchase or redeem shares directly with the fund. However, **authorized participants** can redeem shares in kind with a pro rata distribution of the underlying fund assets. Those participants can also assemble a package of the underlying fund assets and trade them to the fund in exchange for new shares of the fund. This redemption and purchase in kind (with fund assets instead of cash) creates an arbitrage mechanism between the open-market price of fund shares and NAV. That benefits all investors in the fund. However, the arbitrage mechanism is less effective than in the equity market due to the illiquidity of many underlying bond assets; they are simply harder to buy or sell at the expected fair price.

Synthetic strategies seek to replicate the performance of bond indexes with OTC or exchange-traded derivatives. Such strategies include:

PROFESSOR'S NOTE



Most of these approaches are illustrated in more detail in the derivatives study session and will be covered there. This reading is essentially an overview of the derivatives approaches.

Total return swaps (TRS): The manager enters a swap to receive a desired bond market index total return (both income and price change) in exchange for paying LIBOR + spread. TRS are equivalent to buying the index and borrowing the funds needed for purchase at LIBOR + spread. If the index has a negative return in a given period, the index receiver pays that return to the index payer to replicate the loss in value that would have occurred if the index receiver had actually invested in the index:

- The investor could fully collateralize the swap by holding sufficient cash equivalents to have purchased the underlying index.
- If not fully collateralized, the TRS is effectively a leveraged investment in the index.
- The counterparty is normally a dealer with greater economies of scale who can replicate the index with lower transaction costs than the manager.
- The TRS has disadvantages compared to direct investment.
  - The user does not directly own the underlying securities. The TRS replicates the underlying return, but there is counterparty (credit) risk if the dealer cannot perform his side of the transaction.
  - The TRS is normally shorter term in nature, and there is rollover risk if it cannot be renewed or a new counterparty cannot be found at expiration of the initial TRS.
  - The specified return can be for a subset of the bond market or a sector where transaction and liquidity issues make direct investment impractical. However, the dealer must reflect these costs in the swap terms—typically increasing the spread to LIBOR paid by the TRS index return receiver.
  - Structural and regulatory changes have been increasing the costs and reducing the flexibility of TRS. Dealers are now required to hold more capital, increasing their costs and making the swap terms they can offer less attractive. Collateral and mark-to-market rules are removing some of the flexibility of these instruments.

Exchange-traded derivatives are another approach to synthetic positions. Structural and regulatory changes are also occurring here. Traditionally, exchange-traded instruments such as futures and options were based on individual bonds (i.e., the CTD bond for Treasury futures and options on futures as well as money market instruments such as Eurodollar futures). Starting in 2006, the United States allowed futures contracts based on bond indexes, but they have not been particularly popular, with some contracts being delisted (no longer traded). Equity ETF futures contacts were introduced in 2005, but with limited liquidity and success. American-style exchange-traded options on interest rate–related ETFs, high yield bonds, corporate bonds, and inflation-protected securities have been more successful (i.e., are becoming more available).

BOND BENCHMARK SELECTION

LOS 23.h: Discuss criteria for selecting a benchmark and justify the selection of a benchmark.

CFA® Program Curriculum, Volume 4, page 102

Benchmark selection begins with defining the client's objectives and constraints, then determining the strategic asset allocation that will meet these requirements. The manager may be given tactical discretion to vary those asset class exposures.

Selecting suitable bond indexes can be more complicated than for equity. Here are examples:

- In a static (no changes) bond portfolio, duration will decline as the bonds age.
- New bond issuance may cause the characteristics of the index selected as a benchmark to change over time. For example, issuers may shift to shorter or longer security issuance, making a given index no longer appropriate for a given investor's desired duration.
- Value-weighted indexes give the greatest weight to the largest issuers, which may lead to the "bums problem." A bum is a less creditworthy issuer. There is often a negative correlation between amount of bonds issued and creditworthiness of the issuer; thus, the less creditworthy issuers tend to become an increasing percentage of the index.

A bond investor could start by defining the desired interest rate (duration) risk and sector exposures. That could lead to a custom index (instead of a broad market index) of desired sub-exposures, such as 50% in 5- to 10-year Treasuries and 50% in 1- to 3-year investment grade corporates as a benchmark. (See **credit barbell** in the next paragraph).

Smart beta rules could be used. This means identifying relatively simple, definable rules that can be followed to add value. The custom index explained previously is one such example, and is called a **credit barbell**. Longer-term Treasuries (with no credit or spread risk) are used to give the portfolio the desired duration exposure. Shorter-term corporate securities are used to add additional spread return. Those shorter-term securities will be less vulnerable to relative price underperformance if spreads widen.

MODULE 23.6: INTRODUCTION: BULLET, LADDER, BARBELL

LOS 23.i: Describe construction, benefits, limitations, and risk–return characteristics of a laddered bond portfolio.

Video covering this content is available online.

CFA® Program Curriculum, Volume 4, page 105

A laddered portfolio is a common way to build a bond portfolio for individual clients. Roughly equal par amounts are purchased, and come due each year. The same duration could also be achieved by concentrating all the holdings in a single middle duration (a bullet portfolio) or in a shorter and longer duration (a barbell portfolio). If all three portfolios have the same duration, they all have roughly the same price sensitivity to a parallel yield curve shift. The advantages of the laddered portfolio include:

- The greatest practical advantage is natural liquidity, as some bonds come due each year. This is particularly significant if less liquid bonds such as corporates are used. The need to sell at large bid-ask spread to meet cash flow need is reduced. Alternatively, these now near-to-maturity bonds would be treated as less risky collateral, and could be used to borrow at favorable interest rates.
- There is the broadest diversification of cash flow across time and the yield curve —hence, less concentrated exposure to twists in specific points on the curve.
- There is diversification between price and reinvestment risk. Regarding price risk, some bonds mature each year (see natural liquidity). Regarding reinvestment risk, some bonds mature each year, so some proceeds will be reinvested at higher and some at lower rates. This creates a form of dollar cost averaging.
- The laddered portfolio will have more convexity than the bullet, a benefit if there are large parallel shifts. Recall that that distribution of cash flows is directly dispersion related to convexity.
- The duration contributions and key rate durations of the bullet, ladder, and barbell will also differ. So, the portfolios will respond differently to nonparallel twists in the curve. The ladder will typically fall in the middle of such curve risk exposure.

An alternative to building laddered bond portfolios with individual bonds is to use a laddered portfolio of **target-date** (fixed-maturity) bond ETFs. Each ETF has a designated year when it will mature and be paid off. It is passively managed to replicate the performance of a bond maturing in that year. For many investors, the ETF will offer cost advantages compared to purchasing individual bonds and have more liquidity if unanticipated sales are needed.

Laddered portfolios do have disadvantages. For some investors, an ongoing (no target date) passive index or active bond fund may be better. These ongoing funds are likely to be larger, provide greater diversification of credit risk, and be more liquid.

MODULE QUIZ 23.5, 23.6

To best evaluate your performance, enter your quiz answers online.

1. Using a full replication approach for bond indexing may be impractical, given the large size of the bond market and the varying characteristics of individual bonds. Instead, it may be easier to match the primary risk characteristics of the selected bond index. When reviewing specific risk characteristics, the risk factor that minimizes tracking error due to nonparallel shifts in the yield curve is associated with matching:
   A. modified duration.
   B. key rate durations.
   C. issuer exposure weights.
2. A bond portfolio manager is looking to gain passive exposure to the bond market. Which of the following approaches would allow the manager to receive the return from a desired bond market index in exchange for paying LIBOR plus a spread?
   A. Total return swap.
   B. Exchange-traded funds (ETFs).
   C. Exchange-traded derivatives.
3. Which of the following statements regarding fixed income benchmarks is *most likely* false?

A. If a static bond index is used as a benchmark, the duration will remain the same as the bonds age.
B. New bond issuance may cause the characteristics of the selected benchmark to change over time.
C. Issuers may shift to shorter or longer security issuances, making a given benchmark no longer appropriate for a given investor.

4. A client at RBI Funds would like to build a laddered bond portfolio. In terms of the construction and advantages of a laddered portfolio, which of the following statements is *most correct*?
   A. With a laddered portfolio, the investor is diversified between price and reinvestment risk.
   B. A laddered portfolio has more reinvestment risk in any single year compared to a barbell portfolio.
   C. The more distributed cash flows of a ladder portfolio compared to a bullet portfolio will provide less convexity.

KEY CONCEPTS

LOS 23.a

- Liability-driven investing is a form of asset-liability management (ALM) that manages the assets in relation to the characteristics of the liabilities. This is easier when the future liability payouts are known in amount and timing. The liabilities are essentially the benchmark for making decisions.
- Asset-driven investing is a less common form of ALM and adjusts the liabilities in relation to the characteristics of the assets.

LOS 23.b

Immunization can be used to fund liabilities with a high degree of certainty. The assets are dedicated to this purpose and all cash flows are reinvested until needed for payout.

Cash flow matching is without risk, assuming there are no defaults. Bonds are bought and held in sufficient amount and pay date to meet the liabilities. It is the most restrictive strategy, and so typically costs more (has lowest return).

Duration matching achieves similar results, but is less restrictive in the assets selected. Matching Macaulay duration of the assets to liabilities balances the exposure between price and reinvestment risk. Duration and other portfolio statistics should be based on portfolio yield (IRR). To immunize a single-period liability:

- Initial PVA equals (or exceeds) PVL. (There are exceptions to this for more complex situations where initial portfolio IRR differs from initial discount rate of the liability.)
- Match Macaulay durations ($D_A = D_L$).
- Minimize portfolio convexity.
- Rebalance the portfolio to maintain the duration match.

Immunization (duration matching) issues include the following:

- The assets have greater convexity than the single date liability; therefore, the portfolio benefits from large parallel shifts but is at risk from curve twists (nonparallel shifts). Minimizing convexity minimizes this structural risk.
- Immunization can be interpreted as zero replication, meaning a successful immunization will replicate the price and yield path of a zero-coupon bond that could have been used for a perfect cash flow match immunization.

LOS 23.c

Multiple liabilities can be cash flow matched with a portfolio of zero-coupon bonds or coupon-bearing bonds whose cash flows (P&I) most closely match the liability payouts. Duration matching can be done by matching the BPV of the assets and liabilities. The rules are as follows:

1. Initial PVA equals (or exceeds) PVL (see the caveat given under single liability rules).
2. $BPV_A = BPV_L$
3. Asset dispersion of cash flows and convexity exceed those of the liabilities. (But not by too much, in order to minimize structural risk exposure to curve reshaping).
4. Regularly rebalance the portfolio to maintain the BPV match.

Derivatives are often used to adjust the BPV of the assets and hedge or partially hedge the duration gap:

- Buying (selling) futures or receive (pay) fixed swaps increases (decreases) asset duration and BPV.
- Futures BPV ≈ BPV_{CTD} / CF_{CTD}
  - BPV = MD × V × 0.0001
- N_f = (BPV of liability − BPV of current portfolio) / BPV of futures.
- NP for swap = (BPV of liability − BPV of current portfolio) / BPV of 1 NP for the swap.
  - BPV_{swap} is the difference in BPV of fixed and floating side.

Contingent immunization (CI) requires the portfolio be overfunded with a positive surplus (PVA > PVL). If the surplus is positive, the portfolio can be actively managed (not immunized):

- If active management is successful, the return will exceed the initially available immunization rate, the surplus will grow, and ultimate cost of the strategy will be less than immunizing.
- If active management fails, the surplus will decline to zero and the portfolio must be immunized. The ultimate cost will exceed that of immunizing.

LOS 23.d

A 100% hedge eliminates the duration gap (matches BPV of assets and liabilities). In the normal scenario of $BPV_A < BPV_L$, a manager who expects interest rates to:

- Increase will reduce the hedge size, leaving the BPV of assets less than of a fully hedged duration gap. Leaving the BPV of assets at a lower level means they will decline in value less as interest rates increase.
- Decrease will increase the hedge size, increasing the BPV of assets above that of a fully hedged duration gap. Increasing the BPV of assets means they will increase in value more as interest rates decrease.

Regarding the three swap methods of reducing a negative duration gap (increase BPV of assets):

- Entering a receive-fixed swap is generally optimal if interest rates in the future are below the swap's SFR.
- Using a zero-cost collar (buy receiver swaption and sell payer swaption) is generally optimal if interest rates in the future are moderately higher (i.e., between the swap and payer swaption SFRs).

- Buying a receiver swaption is generally optimal if interest rates in the future exceed the payer swaption SFR by some amount.

LOS 23.e

Risks include:

- Hedge amounts are approximations based on assumed durations and ignore convexity.
- Duration assumes parallel shifts in the curve.
- Twists in the yield curve can create structural risk (risk due to curve reshaping).
- Multiple assumptions (model risk) are required to model the characteristics of complex liabilities, such as those in DB plans.
- Measurement error issues occur when weighted average characteristics are used instead of portfolio statistics based on portfolio yield (IRR).
- Futures base calculations are approximations based on an assumed CTD bond, and that CTD can change.
- Spread risk exists if the relationship between asset yield and liability discount rate changes.
- Traditionally, OTC derivatives have counterparty risk.
- Cash flow risk for exchange-traded and OTC derivatives requiring cash settlement of gain/loss or margin.
- Asset liquidity risk if positions cannot be quickly adjusted at near fair market value.

LOS 23.f

Bond index funds offer low cost diversification. Their goal is to minimize tracking error. But there are challenges (compared to equity):

- A much larger number of bond issues with diverse characteristics exists. This generally makes full replication impractical.
- Liquidity has declined post-2008, is often low, and varies by bond issue.
- Trading is OTC, and dealers have become less able to supply liquidity.
- Most individual bonds rarely trade, and price must be estimated based on matrix pricing.
- Bond index composition and characteristics can change.

Enhanced indexing matches the primary risk factors of the index. To minimize tracking error:

- Match modified duration—and effective duration if there are option features.
- Match key rate durations.
- Match weighting exposure to the various bond sectors, quality ratings, issuers, and all other material factors. Cell matching is a common technique used to do this.

LOS 23.g

Passive bond market exposure can be achieved with:

- A separately managed account that replicates the index.
- Index mutual funds, either open ended or ETFs.
- Synthetic strategies, including:
    - Total return swaps, receiving a bond index return.
    - Futures or options based on bond instruments.

LOS 23.h

Determine the client's objectives and constraints before finalizing the strategic asset allocation. Then, select a bond index that matches the objectives and constraints as well as the desired asset class characteristics. Selecting a suitable index is complicated by:

- The possible decline in index duration as the bonds age.
- The changing characteristics of many indexes over time as the holdings change.
- The "bums problem" in value-weighted indexes as the largest issuers become a greater percentage of the index, but large issuance is often associated with increasing leverage and declining credit quality.

LOS 23.i

Laddered portfolios:

- Provide diversification across the yield curve and natural liquidity as a portion of the bonds come due each year. In an upward sloping yield curve, this can also be desirable as each maturing bond is rolled over into the longest (and highest yielding) maturity used in the ladder.
- Have more convexity than a bullet portfolio because their cash flows are more distributed.
- Could be constructed with a sequence of target-date ETFs as an alternative to individual bonds.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 23.1, 23.2

1. **B** Type I liabilities have known future amounts and payout dates. The issuer of an option-free fixed-rate bond has this type of liability. These are the easiest to manage liabilities because their sensitivity to interest rate movements can be modeled using modified duration. Callable bonds have known future amounts, but uncertain payout dates (Type II). Real rate bonds, such as Treasury inflation-protected securities, have uncertain future amounts, but known payout dates (Type III). (Module 23.1, LOS 23.a, 23.b)

2. **A** Rules for immunizing a single liability include the following:
   - Initial portfolio market value (PVA) equals (or exceeds) PVL.
   - Portfolio Macaulay duration matches the due date of the liability (DA = DL).
   - Minimize portfolio convexity (to minimize dispersion of asset cash flows around the liability and reduce risk to curve reshaping).

   (Module 23.1, LOS 23.b)

3. **C** Contingent immunization is a hybrid active/passive strategy. It requires initially overfunding the portfolio with more assets than needed to immunize and meet the future liability. As long as that surplus is of sufficient size, the portfolio can be actively managed. A derivatives overlay uses Treasury futures contracts to adjust the portfolio. Cash flow matching creates a portfolio of zero-coupon bonds to match cash inflows with cash outflows. (Module 23.2, LOS 23.b)

Module Quiz 23.3, 23.4

1. **B** The basis point values (BPVs) per 100 notional for each side of the swap and the net swap duration are computed as:

   fixed-side BPV = 100 × 8.25 × 0.0001 = 0.0825

   floating-side BPV = 100 × 0.5 × 0.0001 = 0.005

   net swap BPV = +0.0825 − 0.005 = 0.0775

   The notional swap principal required to close the duration gap for a 100% hedge is the duration gap in BPV divided by the swap BPV per 1 NP.

   NP = 300,000 / (0.0775 / 100) = 387 million

   Note that the case never said if BPV of assets or liability is larger. Thus, we can compute the size of the swap, as asked, but not if it is a pay- or receive-fixed swap. (Module 23.3, LOS 23.d)

2. **C** An example of spread risk occurs when the portfolio yield and liability discount rate differ, which reflects different risk levels. If the spread between the two rates changes, the change in rates of the two cannot match; their present values may not change in the expected ways. Using only duration will ignore convexity, which will result in some error. Not being able to adjust positions with reasonable transaction costs is an example of asset liquidity risk. (Module 23.4, LOS 23.e)

Module Quiz 23.5, 23.6

1. **B** Matching key rate durations minimizes tracking error due to nonparallel twists in the yield curve. Matching modified duration minimizes tracking error due to parallel shifts in the yield curve. Matching issuer exposure weights controls for specific event risk that affects only that issuer, such as bankruptcy. (Module 23.5, LOS 23.f)
2. **A** In a total return swap, a manager enters a swap to receive a desired bond market index total return (both income and price change) in exchange for paying LIBOR + spread. If the index has a negative return in a given period, the index receiver pays that return to the index payer to replicate the loss in value that would have occurred if the index receiver had actually invested in the index. (Module 23.5, LOS 23.g)
3. **A** In a static (no changes) bond portfolio, duration will decline as the bonds age. New bond issuance may cause the characteristics of the selected benchmark to change over time. Issuers may shift to shorter or longer security issuance, making a given index no longer appropriate for a given investor. (Module 23.5, LOS 23.h)
4. **A** With a laddered portfolio, the investor is diversified between price and reinvestment risk. Some bonds mature each year and can be reinvested if rates are high. This creates a form of dollar cost averaging over time. The ladder has less reinvestment risk in any single year versus the barbell (or bullet). The more distributed cash flows of the ladder compared to the bullet will provide greater convexity—benefitting performance for large changes in rates. (Module 23.6, LOS 23.i)

The following is a review of the Fixed-Income Portfolio Management (2) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #24.

READING 24: YIELD CURVE STRATEGIES

Study Session 12

EXAM FOCUS

Now we turn to ways to add value by positioning portfolio exposures along the yield curve. You will see many concepts already discussed, such as bullet versus ladder versus barbell, adjusting convexity, and PVBP (which a previous reading referred to as BPV). Think of this as positioning on a credit risk-free government yield curve to add value. The next reading will focus on adding value through credit risk decisions.

MODULE 24.1: INTRODUCTION AND STRATEGIES FOR AN UNCHANGED CURVE

Video covering this content is available online.

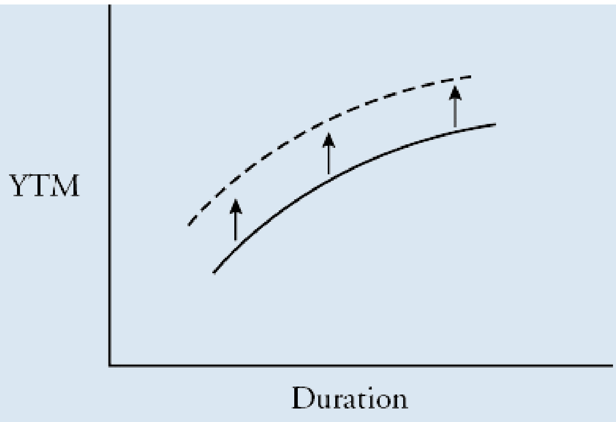
Active management requires the manager to have a view of what will happen. If the manager acts on this view, is correct, and the view was not already reflected in security prices, the actions can add value to the portfolio's performance.

A yield curve shows the yield as a function of maturity (or sometimes of duration) for otherwise comparable bonds. Yield curves are most typically plotted for credit risk-free government bonds because they are generally available for a wide range of maturities and do not introduce the additional complexity of changes in credit spread. The "yield" could be yield-to-maturity (YTM), spot rates, or even forward rates. For our purposes, the yield will be YTM unless clearly indicated otherwise. Thus, in the United States, the typical yield curve will be for YTM as a function of maturity for U.S. Treasury securities.

Yield curves are generally not stable but change over time. To determine how to profit from expected changes in the yield curve, it is helpful to view yield curve changes as coming from three sources. Change in:

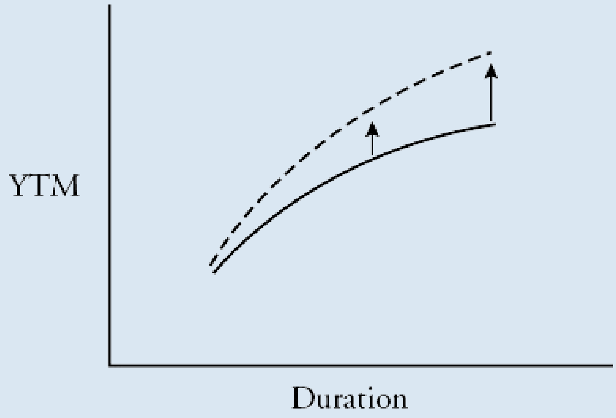
1. Level: A parallel shift where all yields shift up (or down) by the same amount.

EXAMPLE: An upward parallel shift



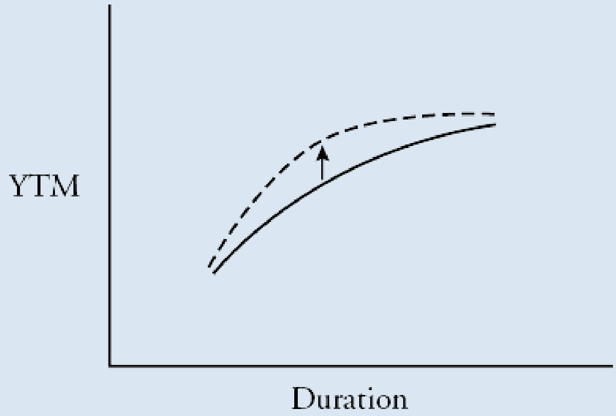
2. Slope: Where the curve becomes flatter or steeper.

EXAMPLE: A steepening



3. Curvature: Where the curve becomes more like a straight or curved line.

EXAMPLE: Increased curvature



In reality, most changes in the curve involve more than one source.

EXAMPLE 1: The Three Sources of Change in the Yield Curve

A manager makes the following projection of change in level, slope, and curvature for the yield curve.

Maturity:	1 year	2 year	5 year	10 year	20 year

Yield Today	1.1%	1.2%	1.3%	1.4%	1.4%
Projected Yield in 3 Months	1.2%	1.4%	1.6%	1.6%	1.6%.

Discuss each of the *three* changes reflected in the manager's projection for the change in the curve.

Answer:

Level: All rates are projected to increase, which has elements of an upward shift.

Slope: Longer rates are increasing more than shorter rates, which has elements of a steepening.

Curvature: Intermediate (the 5-year) rates increase the most, which has elements of increasing curvature.

PROFESSOR'S NOTE

We are going to first look at simpler situations where the right strategy is fairly straightforward to determine. Then we move to more complex situations where determining the optimal strategy may require additional quantifiable assumptions and calculations.

All of the CFA text is premised on an upward sloping curve that is concave. That is true in the graphs of curve change in Example 1. This is the overwhelmingly normal situation. So, for exam purposes, confine your preparation to what we can conclude for upward sloping concave curves, unless clearly directed otherwise.

Also recall that:

$\%\Delta V = -D\Delta r + 1/2C\Delta r^2$

$$C = \frac{\text{Macaulay duration}^2 + \text{Macaulay duration} + \text{dispersion}}{(1 + \text{periodic IRR})^2}$$

STRATEGIES FOR A STABLE CURVE

LOS 24.a: Describe major types of yield curve strategies.

LOS 24.b: Explain how to execute a carry trade.

LOS 24.c: Explain why and how a fixed-income portfolio manager might choose to alter portfolio convexity.

CFA® Program Curriculum, Volume 4, pages 134 and 136

买期限长 **Buy and hold:** In an upward sloping curve, extend maturity (and therefore duration) to earn a higher yield and expected return. Another advantage of this strategy will be low turnover and transaction costs. This strategy is not necessarily passive if it involves selecting a duration or exposure to points on the yield curve (where rates are expected to be stable) that differ from the portfolio's benchmark.

买陡峭的点 **Ride the Yield Curve:** This strategy is based on the fact that as time passes, the bond's remaining maturity and duration decrease. In an upward sloping curve, that means its yield will decline as time passes. It differs from buy and hold in that the manager will look to find the bond with a combination of higher duration and positioned at the end of a relatively steep portion on the curve so that as time passes and its yield declines, the bond will offer the greatest increase in price. Then, after the yield declines, the manager sells the bond and rolls out the curve to repeat the process by buying another bond at the end of a steep segment of the curve. Buying bonds at the end of a steep segment of the curve also means they have an initially higher yield, which also adds to the return earned.

借低买高 **Use a Carry Trade:** A carry trade is just another form of leverage. Return is enhanced by borrowing at a lower rate to invest the funds in an asset that will generate a higher rate of return. In a stable upward sloping curve, borrow at lower shorter-term rates to invest at higher longer-term rates. We will return to a further discussion of carry trades shortly.

假定YC稳定

Sell convexity: This means select bonds or a portfolio with lower convexity. By itself, positive convexity (+C) is beneficial. It means that if there is a large decline in interest rates, the increase in the bond's price will be greater than expected from duration alone. Or if there is large increase in interest rates, the decrease in the bond's price will be less than expected from duration alone. Thus, +C magnifies the upside and reduces the downside of price movement due to changes in rates. The changes in rates have to be rather large because convexity is a second order impact on price. That means +C has little impact on change in price unless the rate change is significant. Of course there is rarely any free lunch. Bonds or portfolios with higher +C normally have less yield. The conclusion is that if the curve is expected to be stable (little change in rates), there will be minimal or no benefit from +C and the lower yield will reduce return. Thus, it is better to "sell convexity" (reduce convexity) to receive higher yield and expected return. We will return to a further discussion of altering convexity shortly.

MODULE 24.2: STRATEGIES FOR CHANGING YIELD CURVES

Strategies for a Parallel Shift in the Curve

Video covering this content is available online.

LOS 24.a: Describe major types of yield curve strategies.

LOS 24.c: Explain why and how a fixed-income portfolio manager might choose to alter portfolio convexity.

LOS 24.e: Explain how derivatives may be used to implement yield curve strategies.

CFA® Program Curriculum, Volume 4, pages 134, 136, and 143

Adjust Portfolio Duration: A parallel shift in the curve portfolios with the same duration are expected to have the same percentage change in value.

- If rates are expected to increase, decrease portfolio duration before this occurs to minimize the value lost.

- If rates are expected to decrease, increase portfolio duration before this occurs to maximize the value gained.

Of course all changes in duration must be consistent with the portfolio constraints.

Increase Portfolio Convexity: Greater convexity will:

- Increase the value gained if rates decrease.
- Decrease the value lost if rates increase.

The convexity effect will only be material if the rate change is significant and it will involve accepting less yield (assuming rational pricing of assets in the market).

Strategies for a Nonparallel Shift in the Curve

LOS 24.a: Describe major types of yield curve strategies.

CFA® Program Curriculum, Volume 4, page 134

The basic concept is simple. First, determine the appropriate duration for the portfolio. Within that constraint of meeting, target total duration:

- Increase exposure to those points on the curve where rates are expected to show a relative decrease in level.
- Decrease exposure to those points on the curve where rates are expected to show a relative increase in level.

The simplest way to implement this strategy is selection of a bullet versus barbell portfolio.

- The bullet portfolio concentrates exposure in the desired total portfolio duration point of the curve (denoted here as M for middle).
- The barbell portfolio concentrates exposure at shorter and longer points of the curve to achieve the same desired total portfolio duration (denoted here as S and L for shorter and longer).
- A laddered portfolio would distribute exposure more evenly along the curve between S and L.

EXAMPLE 2: Selection of Curve Strategy

Consider a portfolio with a benchmark that is laddered and has a duration of 10. The manager is considering three possible strategies:

1. Ladder: Match the benchmark which has an equal distribution of 1 to 19 duration bonds for portfolio duration of 10. The yield and convexity are 4.39% and 20.1 respectively.
2. Barbell: 50% in securities with a duration of 2 and 50% in securities with a duration of 18, for portfolio duration of 10. The yield and convexity are 4.30% and 24.7 respectively.
3. Bullet: 100% in securities with a duration of 10. The yield and convexity are 4.51% and 16.4 respectively.

A. **State** and **justify** the optimal strategy if the manager expects a small and very near term parallel upward shift in the yield curve.

B. **State** and **justify** the optimal strategy if the manager expects a large parallel and very near term upward shift in the yield curve.

C. **State** and **justify** the optimal strategy if the manager expects a large parallel downward shift in the yield curve over the next 12 months.

D. **State** and **justify** the optimal strategy if the manager expects an immediate steepening of the curve with short rates (duration of 1) decreasing 50 bp, no change in intermediate rates (duration of 10), and long rates (duration of 19) increasing 50 bp.

E. **State** and **justify** the optimal strategy if the manager expects an immediate steepening of the curve with short rates (duration of 1) decreasing 10 bp, intermediate rates (duration of 10) increasing 40 bp, and long rates (duration of 19) increasing 90 bp.

F. **State** and **justify** the optimal strategy if the manager expects an immediate flattening of the curve with short rates increasing 50 bp, no change in intermediate rates, and long rates decreasing 50 bp.

Answers:

A. There is no distinct advantage for any strategy. They all have the same duration and expected change in value for a parallel shift. The bullet has a yield advantage, but over a short time period that will not matter much. The barbell has more convexity but for a small change in rates that will not matter much. The ladder more closely matches the portfolio benchmark's duration distribution but has no material expected return advantage in this scenario.

B. The barbell. With a large increase in interest rates, the higher convexity of the barbell will produce the greatest cushioning of price decline.

C. There is no distinct advantage for any strategy. There are conflicting issues. They all have the same duration. The bullet has a yield advantage over the next 12 months. The barbell has more convexity which will increase its value gain for a large decrease in rates. The ladder more closely matches the portfolio benchmark's duration distribution but has no material expected return advantage in this scenario.

D. The bullet is best. With no change in intermediate rates, it will not decline in value. The others will decline in price. The manager has described a pivot in the curve. With long rates up 50 bp and high duration there will be a large decline in value. The 50 bp decrease in shorter rates with less duration will not produce as large a value gain. Thus the barbell will decline the most and the ladder will decline some.

E. The bullet is best for the same reasons it is best in part D. There is a steepening and that favors the bullet. There are also elements of a parallel upward shift, but all strategies have the same duration and respond the same to a parallel shift, ignoring the small convexity effect.

F. The barbell because it has the most exposure to long duration assets where rates will decrease. This will give it the largest value gain.

MODULE 24.3: ADJUSTING CONVEXITY

LOS 24.c: Explain why and how a fixed-income portfolio manager might choose to alter portfolio convexity.

Video covering this content is available online.

CFA® Program Curriculum, Volume 4, page 136

As we have seen previously and all else the same, it is beneficial to have greater convexity when large changes in rates are expected The convexity will magnify value gain when rates decrease and cushion price loss when rates increase. However, there is likely to be a cost in the form of lower yield (and income from the portfolio). To adjust convexity, use the following:

Barbell vs. Bullet Structure

- To increase convexity, the more distributed future cash flows of a barbell will have higher convexity, but lower yield.

- To decrease convexity, the more concentrated future cash flows of a bullet will have lower convexity, but higher yield.

Generally, shifting between barbell and bullet structures has only a modest impact on convexity, holding total duration the same. Options can have a much more dramatic impact on convexity.

Options on Bonds

- Long call options on bonds (or on bond futures contracts) increase in value as the underlying increases. Thus they provide increased upside as bond prices increase and rates decline. More upside means more positive convexity.
- Long put options on bonds (or on bond futures contracts) increase in value as the underlying decreases. Thus they reduce the downside as bond prices decline and rates increase. Less downside means more positive convexity.

To adjust convexity using bond options:

- Buy call and/or put options to increase convexity. The premiums paid to buy the options effectively reduce the yield earned on the portfolio.
- Sell call and/or put options to decrease convexity. The premiums received from selling the options effectively increases the yield earned on the portfolio.

Many portfolios have constraints that restrict the use of options. The use of bonds with embedded options can be an alternative way to adjust convexity.

Bonds with Embedded Options

- Callable bonds can be decomposed as an option-free bond and a short call position on the underlying bond. If rates decline the issuer's right to call the bond increases in value and the price upside of the bond is limited. Thus the callable bond has diminished in value given its negative convexity (at lower rates) compared to an otherwise equivalent option-free bond. Callable bonds have a higher yield than an equivalent option-free bond.
- Mortgage backed securities (MBSs) behave in a similar fashion to a callable bond. Although the behavior of a pool of borrowers in an MBS is typically more difficult to predict than the behavior of a callable bond issuer, if rates decline, the borrowers have an incentive to prepay the mortgages. This limits the price upside of the MBS as rates decline. MBSs offer a higher yield than other bonds for equivalent duration and credit quality.
- Putable bonds are the economic opposite of callable bonds. They can be decomposed as an option-free bond and a long put position on the underlying bond. If rates increase, the owner of the bond can put the bond to the issuer. The owner's right to put the bond increases in value and reduces the price downside of the bond as rates increase. Thus the putable bond has increased positive convexity (at higher rates) compared to an otherwise equivalent option-free bond. Putable bonds have lower yield than an equivalent option-free bond.

To alter portfolio convexity:

- Increase holdings of callable bonds and MBSs and/or decrease holdings of putable bonds to decrease convexity (and increase yield).

callable, MBS -> C-

Puttable -> C+

- Decrease holdings of callable bonds and MBSs and/or increase holdings of putable bonds to increase convexity (and decrease yield).

MODULE 24.4: CARRY TRADES

LOS 24.b: Explain how to execute a carry trade.

CFA® Program Curriculum, Volume 4, page 136

Video covering this content is available online.

To repeat an earlier comment, “a carry trade is just another form of leverage. Return is enhanced by borrowing at a lower rate to invest the funds in an asset that will generate a higher rate of return.” There are many ways to implement a carry trade.

1. In a stable upward sloping curve, the carry trade can be implemented by **borrowing at lower shorter-term rates to invest at higher longer-term rates**. The expected stability of the curve is important because if shorter-term rates increase, the cost of borrowing can rise enough to make the trade unprofitable. An even greater risk is increasing longer-term rates which lower the value and return on the longer-term bond that was purchased.

   This carry trade is also a form of a yield curve trade in that the interest paid depends on shorter-term rates and the return on the asset purchased depends on longer-term rates.

2. Another approach is to **borrow in a lower interest rate and invest in a higher interest rate currency**. *This was covered in the currency readings and is a cross-border trade involving two currencies.* There is again a risk that the borrowing cost can increase or asset value and return can decline. Change in exchange rate value adds another risk in a dual currency carry trade. If the value of the currency invested in declines, it will take more of those currency units to repurchase and pay off the currency borrowed. A sufficient decline in currency value could offset the net positive expected interest earnings on the trade.

   The currency risk in such carry trades cannot be hedged because interest rate parity dictates that the currency with the higher yield will trade at a forward discount to the lower yield currency. If the currency were hedged, it would offset the short-term interest rate differential in the two countries.

   A currency swap provides another way to achieve the results of a cross-border carry trade. Consider a cross-border trade of borrowing in currency X at 2% to invest in currency Y at 5%. There is no initial net investment but there are future cash flows. An alternative is to enter a currency swap to pay 2% on currency X versus receive 5% on currency Y. There is again no initial net investment because while notional principals are exchanged, that is done at the initial spot exchange rate so it has no initial net economic value. In both cases, the notionals must be paid back at the end and that does create risk if the currency to be repaid has increased in value.

The use of swaps introduces even more flexibility to structure the trade. Consider simultaneously buying a longer-term bond in a higher yield currency at a perceived attractive longer-term bond interest rate while simultaneously using the bond as collateral for a repurchase transaction to finance the bond purchase. The investor owns the bond and earns its return denoted R_{BHY} for return on a higher yield longer-term bond. On the repo, the investor pays the shorter-term interest rate for that higher yield currency, denote r_{STHY}. This is just a standard borrow shorter-term to invest longer-term single currency carry trade. To make it a cross-border trade, enter a currency swap to receive r_{STHY} versus pay a shorter-term rate in a lower yield currency, denoted denote r_{STLY}. The net result is earn R_{BHY} versus pay r_{STLY}. The net result is an ability to invest at the highest perceived LT rate and pay the best perceived ST rate.

There is a common misconception that the forward exchange rate should be used as a valid prediction of how the value of a currency will change over time. The empirical evidence generally refutes this. Generally, the higher interest rate currency appreciates in value and that adds to the return of the higher yield market invested in.

There is still currency risk in dual currency carry trades. In a market crisis, the higher yield currencies may well collapse in value and produce significant losses on the carry trade. If the carry trade has become highly popular and widely used, that can itself contribute to the crisis. A highly popular carry trade once involved borrowing at low JPY interest rates to invest in higher USD interest rates. However, if the USD started to decline for any reason, the investors in the USD security were at risk. They may move to sell the USD securities, use the USD to buy JPY, and repay the JPY borrowing, closing out the carry trade. But selling the USD to buy the JPY will itself drive down the USD and drive up the JPY. Selling the USD securities also drives down their price for others trying to exit the carry trade. This mass effort to unwind a trade has been called crowding risk. Carry trades do best in stable markets and can be very risky in highly volatile markets.

EXAMPLE 3: Dual Currency Carry Trades

A U.S.-based investment firm is expecting stable economic and interest rate conditions. The firm wants to use carry trades to enhance expected return. The firm collects yield curve information on the U.S. and two foreign markets. All rates are annualized with semiannual payment.

Table A: Swap Fixed Rates versus LIBOR Flat

	6 month LIBOR	1 year	2 year	3 year
USD	0.8%	1.4%	1.5%	1.7%
AUD	1.0%	1.3%	1.2%	1.1%
EUR	0.4%	1.0%	1.5%	1.9%

A. **Determine** the most profitable carry trade that can be executed in a single market and the expected return over a 6-month period. **Show** your calculations.

B. **Determine** the most profitable dual currency carry trade that borrows and lends at the same point on the yield curve. **Calculate** its expected simple annual return.

After considering a variety of additional factors, the firm decides on a new carry trade to borrow at 6-month U.S. rates and invest at 3-year EUR rates.

C. **Discuss** *three* risks in this new carry trade. Your answer must discuss *both* currency and interest rate risks.

D. **State** how to structure a currency swap that could have been used to provide the same results as this new carry trade. Assume the currency swap is the only transaction to be used.

Answer:

6m 3y

A. In EUR, borrow at 0.4% to invest at 1.9%. Expected 6-month return is (1.9 – 0.4) / 2 = 0.75%.

In USD, the return is (1.7 – 0.8) / 2 = 0.45%.

? ? ?

In AUD, the return is (1.3 – 1.0) / 2 = 0.15%. Note that the best long position is in the 1-year bond for the AUD market.

B. Borrow for 3 years at 1.10% in AUD and invest for 3 years at 1.9% in EUR for an expected spread return of 80 bp per year. (Note the *next best* trade is borrow for 6 months at 0.4% in EUR and invest for 6 months at 1.0% in AUD for an expected spread return of 60 bp per year.) It also assumes you can roll the trade over for a second 6-month period at the same rates.

C.

- The EUR can depreciate, in which case, more EUR will be required to pay off the USD borrowing.
- If 6-month USD interest rates increase, the cost of borrowing will increase over time.
- If 3-year EUR rates increase, the value and return earned on the EUR asset will decline. ? ? ?

D. Pay 6-month USD LIBOR versus receive a 1.9% EUR fixed rate. The swap term is 3 years.

MODULE QUIZ 24.1, 24.2, 24.3, 24.4

To best evaluate your performance, enter your quiz answers online.

1. A bond trader wishes to overweight short and long maturities along the yield curve, while reducing holdings in the middle maturity securities, relative to the benchmark portfolio. This yield curve strategy will outperform a laddered portfolio strategy when the yield curve:
   A. flattens.
   B. steepens.
   C. remains the same.

   长端利率下行，债券获益大

2. A fixed-income portfolio manager wishes to increase portfolio convexity in order to address interest rate volatility. Portfolio convexity can be increased by:
   A. increasing the portfolio weights at both the long and short ends of the yield curve.
   B. shifting to lower convexity securities relative to those in the benchmark portfolio.
   C. selling calls on portfolio bonds and selling puts on bonds that the manager would like to own.
3. Which of the following carry trades will involve both yield curve and currency risk for a U.S.-based investor?
   A. A 5-year swap of USD fixed-rate payments for JPY 6-month LIBOR received.
   B. A 7-year swap of EUR fixed-rate payments for GBP fixed-rate received. fixed for fixed
   C. Buy 6-year JPY fixed-rate bonds and short 6-year GBP bonds. fixed for fixed

MODULE 24.5: DETERMINING AN OPTIMAL STRATEGY

LOS 24.d: Formulate a portfolio positioning strategy given forward interest rates and an interest rate view.

Video covering this content is available online.

CFA® Program Curriculum, Volume 4, page 152

In some cases, the optimal strategy is less obvious and requires further analysis. Let's consider an example based directly on the CFA® exhibits in this reading, examining a universe of five default-free government bonds. Assume the manager can use any long-only allocation and at most 100% can be invested in any single bond. The assumed holding period is one year. For simplicity, all bonds are annual pay and priced at par (100).

Figure 24.1: Approaches to Selecting the Optimal Bond Strategy, Based on CFA Exhibits 18 and 19

		Assume stable curve		Manager forecast: 60bp upward parallel shift			Implied forward yields and change	
		一年后的价钱 假设利率不变	持有一年后收益		一年后的价钱 假设利率=forecast		先bootstrap算spot 再算forward	
Maturity	**Coupon** (0)	**Rolldown price (1)**	**Holding period return (2)**	**Yield (3)** (0)+60bp	**Price (4)**	**Return (5)**	**Implied forward yield (6)**	**Implied yield change (7)**
1 year	1.50%	100.00	1.50%	2.10%	100.00	1.50%	2.33%	+83bp
2 year	1.91%	100.40	2.31% = (100.4+1.91) / 100	2.51%	99.81	1.72% = (99.81+1.91) / 100	2.61%	+70bp
3 year	2.23%	100.62	2.85%	2.83%	99.46	1.69%	2.85%	+62bp
4 year	2.50%	100.78	3.28%	3.10%	99.06	1.56%	3.07%	+57bp
5 year	2.74%	100.90	3.64%	3.34%	98.67	1.41%	3.27%	+53bp

PROFESSOR'S NOTE

This analysis is based on a large quantity of underlying calculations. The CFA® text includes, in small print, a comment that "calculating…is not the focus." The rest of this Professor's Note is for those who want to go beyond the focus of the reading. After this Note, we will get to the main issues.

Full use and understanding of this analysis requires some additional duration and spot rate information derived from other CFA Exhibits.

Bond Maturity	Derived Spot Interest Rate	Initial Modified Duration (MD)	Projected MD of the Bond in One Year
1	1.5000%	0.985	0.000
2	1.9139%	1.944	0.979
3	2.2403%	2.871	1.930
4	2.5191%	3.762	2.846

5	2.7706%	4.614	3.726

Now, the discussion of Figure 24.1:

1. Rolldown price (1) is the projected price in 12 months if the yield curve is unchanged. For example: The current 1-year bond will mature at par, 100.00. The current 2-year bond will be a 1-year bond trading at 1.50% yield. A price of: 1.91 PMT, 1 n, 100 FV, 1.50 i, Compute PV = 100.40. 1年后的一年利率与现在一年利率一样
2. Holding period return (2) is the (projected price + coupon) / beginning price. For example: The current 1-year bond is (100.00 + 1.50) / 100.00 = 1.50%. The current 2-year bond is (100.40 + 1.91) / 100.00 = 2.31%.
3. Manager forecast yield is purely the manager's prediction for the new level of rates at each point on the yield curve. In this case, the manager has predicted a parallel upward 60bp shift in the curve. For example: The 1-year rate moves from 1.50% to 2.10%. The 2-year rate moves from 1.91% to 2.51%.
4. Manager's forecast of price is the predicted price based on predicted yield. For example: The current 1-year bond will mature at par, 100.00. The current 2-year bond will be a 1-year bond trading at a predicted 2.10% yield. A price of: 1.91 PMT, 1 n, 100 FV, 2.10 i, compute PV = 99.81.
5. Holding period return (5) is the (projected price + coupon) / beginning price. For example: The current 1-year bond is (100.00 + 1.50) / 100.00 = 1.50%. The current 2-year bond is (99.81 + 1.91) / 100.00 = 1.72%.
6. Implied forward yield (6) is calculated from spot rates. The implied spot rates have to first be calculated from the par bond YTMs, which are the coupon rate when bonds trade at par. The CFA® text does not display that information, but these spot rates are calculated using "bootstrapping." That means you must calculate the first spot rate, use it to calculate the second, and then use the first and second to calculate the third, and continue the process. For example: The 1-year bond pays par and first coupon in one year. That is, by definition, a spot instrument, and its 1.50% yield is the 1-year spot rate. The 2-year bond pays two coupons, and that is, by definition, not a spot instrument. The 2-year spot rate can be denoted as "s" and solved by: $(1.91 / 1.015) + (101.91 / (1 + s)^2) = 100$; $s = 1.9139\%$.

   Implied forward rates are then calculated from the spot rates. For example, the forward rate (f) on a 1-year bond in one year is solved by: $(1.019139)^2 = (1.01500)^1 (1 + f)^1$, $f = 2.33\%$. The forward rate (f) on a 2-year bond in one year is solved by: $(1.022403)^3 = (1.01500)^1 (1 + f)^2$, $f = 2.61\%$.

   Notice an important interpretation of the forward rate: Any bond maturing in n periods that trades at its implied forward rate in one year, when it is an n – 1 to remaining maturity bond, will have the same realized return as today's 1-year (one-period) bond. If all bonds trade at their forward rates in one year, all bonds will have had the same realized return as today's 1-year bond: 1.50%. The implications are:

   - Any bond trading (one year from now) at a YTM lower than its implied forward yield will be trading at a price higher than its implied forward price and must therefore have had a realized return higher than the 1.50% realized return of today's 1-year bond.
   - Any bond trading (one year from now) at a YTM higher than its implied forward yield will be trading at a price lower than its implied forward price and must therefore have had a realized return lower than the 1.50% realized return of today's 1-year bond.
7. Implied forward yield change (7) is the forward rate versus existing spot rate. For example: 2.33 – 1.50 = +83bp. 2.61 – 1.91 = +70bp.

The real issue is what do you do with the data?

Key points of the reading:

Approach 1 is to assume the yield curve will be unchanged. Under this assumption and a 1-year holding period, the 5-year bond is the best performing asset with a projected return of 3.64%. This is based on the assumption that in one year, when it is a 4-year bond, it will trade at a yield of 2.50%. 1年后的4年即期等于现在4年即期

Approach 2 is to assume the manager's forecast of the yield curve is correct. Under this assumption and a 1-year holding period, the 2-year bond is the best performing asset with a projected return of 1.72%.

The first two approaches clearly indicate that this is active management. Predict what you think interest rates will do and you can predict what you think the best performing bond will be. You can, of course, come up with other forecasts of the curve that will lead to other conclusions.

A variant of approach 2 is to compare the manager's forecast yield with the implied forward yield. This will reach the same conclusion as approach 2. The manager is forecasting today's 2-year bond will trade at a yield 60bp higher than the current 1-year
? ? ? bond (2.10% versus 1.50%). Compare this to the implied forward rate of 2.33% for the then 1-year bond; the manager predicts a lower ending yield for the bond. Said another way, the manager projects a yield increase of 60bp to 2.1% versus the implied forward yield increase of 83bp to 2.33%. The manager predicts less increase in yield, so the manager predicts a better return (1.72%) for the 2-year bond than the return implied by the forward curve. The manager's projected return is also better than the 1.50% return of today's 1-year bond.

2.10%<2.33%

- We can estimate the manager's projected return on the 2-year bond using duration and the projected yield changes. The manager predicts the then-1-year bond to trade at a yield 23bp lower than the implied forward rate (+60bp versus +83). That differential multiplied by the projected ending duration is a better relative price return: 0.23 × 0.979 = +0.23%. Add the return of today's 1-year bond, and that is the manager's approximate projected return of 1.72% ≈ 0.23 + 1.50.

The same situation exists for today's 3-year bond. The manager projects a yield increase of 60bp to 2.51% versus 1.91%. The implied forward yield increase is 70bp to 2.61%. The manager predicts less increase in yield, so the manager predicts a better return for the 3-year bond than the return implied by the forward curve. The manager's projected return is also better than the 1.50% return of today's 1-year bond.

- We can estimate the manager's projected return on the 3-year bond using duration and the projected yield changes. The manager predicts the then-2-year bond to trade at a yield 10bp lower than the implied forward rate (+60bp versus +70bp). That differential multiplied by the projected ending duration is a better relative price return: 0.10 × 1.93 = +0.19%. Add the return of today's 1-year bond, and that is the manager's approximate projected return of 1.69% ≈ 0.19 + 1.50.

The same analysis and similar results apply to the 4-year bond.

For the 5-year bond, the analysis applies but the situation and results are different. The manager projects a yield increase of 60bp to 3.10% versus 2.50%. The implied forward increase is only 57bp to 3.07%. The manager predicts more increase in yield, so the

3.10%>3.07%

manager predicts a lower return for the 5-year bond than implied by the forward curve. The manager's projected return is now less than the 1.50% return of today's 1-year bond.

PROFESSOR'S NOTE

Please do not shoot the messenger. If you look at our key points above, they are fairly straightforward calculations.

My takeaway would be that an active manager who can forecast ending rates can use those forecasts to identify the best strategy (e.g., approach 2).

MODULE 24.6: USING DERIVATIVES TO IMPLEMENT A YIELD CURVE STRATEGY

LOS 24.e: Explain how derivatives may be used to implement yield curve strategies.

CFA® Program Curriculum, Volume 4, page 143

Video covering this content is available online.

Derivatives often provide a more liquid and less costly alternative to adjusting portfolio duration by selling longer (or shorter) to buy shorter (or longer) bonds in order to shorten (or lengthen) portfolio duration. Given the relatively short life of most derivatives, this makes particular sense when making a temporary adjustment. It can also achieve higher or lower (negative duration) than is possible with unleveraged long-only bond positions.

As is generally the case with derivatives, there are multiple ways to achieve any desired change in duration. All strategies that produce the same net change in duration will be expected to perform the same way for a parallel shift in the curve. However the strategies may achieve the desired total change in duration using instruments tied to different points on the yield curve and they would not all perform the same for nonparallel shifts in the curve. **In general, the optimal strategy to profit from nonparallel shifts will:**

- Take long positions tied to points on the curve expected to show a relative decline in rates.
- Take short positions tied to points on the curve expected to show a relative increase in rates.
- Maintain the desired target total duration.

Changing Portfolio Duration With Futures:

- Buy fixed-income (bond) futures contracts to increase portfolio duration.
- Sell fixed-income (bond) futures contracts to decrease portfolio duration.

The number of contracts to use is:

N_f = Desired change in PVBP / PVBP of the futures contract

PVBP (price value of a basis point) = Value × Mod. D × 0.0001

PROFESSOR'S NOTE

Whenever you see a reference to modified duration, the assumption is there are no embedded (or explicit) options. If the portfolio or bonds include option positions, then modified duration will not provide accurate estimates of price change and effective duration must be used. That means if you are given both modified and effective duration (and they are not the same) there are option positions present and you use the effective duration.

You may also see PVBP calculated as Value × (Mod. D / 10,000). This is the same thing mathematically and both calculate change in value for a 1 basis point change in interest rates. Additionally, you may see CFA authors calculate money duration as Value × (Mod. D / 100) which is equivalent to Value × Mod. D × 0.01. Either indicates change in value for a 1% change in interest rates.

Changing Portfolio Duration With Swaps:

- Enter a receive fixed (versus pay floating) swap to increase portfolio duration.
- Enter a pay fixed (versus receive floating) swap to decrease portfolio duration.

The notional principal of the swap to use is:

NP = Desired change in PVBP / PVBP of the swap

PVBP of the swap is the difference between the fixed and floating side PVBPs

While any bond futures contract or swap can be used to adjust the portfolio duration, the duration of the contract or swap will determine what specific point on the yield curve the derivative will subsequently respond to. In other words, there is also an effect on exposure along the yield curve.

EXAMPLE 4: Adjusting Duration With Futures or Swaps

Consider a $50 million portfolio with a modified duration of 7.27 and effective duration of 7.00. The manager wants to increase duration to 8. Because the portfolio contains bonds with embedded options, the manager focuses on effective duration and calculates the required increase in PVBP as (8 – 7) × 50 million × 0.0001 = 5,000.

The manager collects the following data on futures contracts and swaps:

Futures	Duration	PVBP of contract	
Bond contract	7.5	75.00	
Note contract	2.5	25.00	
Swap*	Fixed Side PVBP*	Floating Side PVBP*	Net PVBP*
5 year	0.0478	0.0025	0.0453
20 year	0.1561	0.0025	0.1536

* All swap PVBP are per 100 notional.

A. **Calculate** the number of note futures contracts (duration of 2.5) to buy to increase the portfolio duration to 8.

B. *If the manager expects the yield curve to flatten,* **explain** which futures contract will be optimal to use.

C. **State** whether to enter a pay or receive fixed swap to increase the portfolio duration to 8 and **calculate** the notional amount in millions. *Answer this question assuming the manager still expects the yield curve to flatten and will select the optimal swap to benefit from that view.*

D. **Calculate** the amount to borrow to increase the portfolio duration to 8 if the manager uses term (not overnight) repos with a duration of 0.25 and uses the repo funds to purchase bonds with a

???

duration of 4.

Answers:

A. 5,000 / 25 = 200 to buy

B. Longer duration rates will decline relative to shorter duration rates increasing. That makes it better to buy the bond contract and be exposed to the relative decline in longer interest rates.

C. Receive fixed and use the 20-year swap to benefit from the manager's expectation of a relative decline in longer interest rates.

NP = 5,000 / 0.1536 = 32,552 hundreds = 3.255 million

D. The duration increase requires adding 5,000 in PVBP. Each dollar of new purchase adds duration of 4 partially offset by a dollar of liability with duration of 0.25. The net effect each dollar borrowed and invested is net 3.75 duration. On a 1 million purchase, that is a money duration addition of 1,000,000(4 – 0.25)(0.0001) = 375. To add 5,000 to portfolio PVBP, purchase (financed by borrowing) 5,000 / 375 = 13.333 million of bonds.

Changing Portfolio Convexity With Options

As we have already covered:

- Buying call options on bonds will increase portfolio upside if rates decline, thus increasing the portfolio's convexity.

buy option -> C+
Sell option -> C-

- Buying put options on bonds will decrease portfolio downside if rates increase, thus increasing the portfolio's convexity.
- Selling call options on bonds will decrease portfolio upside if rates decline, thus decreasing the portfolio's convexity.
- Selling put options on bonds will increase portfolio downside if rates increase, thus decreasing the portfolio's convexity.

Any such strategy will normally involve keeping portfolio duration the same. To keep total PVBP the same, the par (value controlled) of the option will equal the par of the bond multiplied by the ratio of the PVBPs of the bond and option. Any excess cash or cash required is assumed to earn a short-term cash return with no duration.

EXAMPLE 5: Adjusting Convexity With Options

Assume the manager wants to increase portfolio convexity. The portfolio already owns 30-year Treasury bonds with a PVBP of 0.193 and has call options with a PVBP of 0.136.

A. **State** the transactions the manager will make using the two assets already in the portfolio and **calculate** the *ratio* of par amount to be used in each of the two positions.

B. **Explain** why the manager will want interest rate volatility to increase or decrease and whether this needs to occur quickly or not.

Answers:

A. Sell the bonds and buy the calls. To keep duration the same, the par (controlled) of options purchased will be 0.193/0.136 × the par of bonds sold. Note that option premiums are small in relation to the bond value controlled so the net excess funds from the bond sale will be invested in cash.

B. Volatility must increase to make the options purchased more valuable and the sooner (more quickly) that occurs the less income will be lost from not owning the bonds.

MODULE QUIZ 24.5, 24.6

To best evaluate your performance, enter your quiz answers online.

1. A manager calculates the implied forward rate to exist in one year for today's 5-year bond to be 4.75%. That same 5-year bond yields 4.85% today and the 1-year bond today yields 3.5%. The manager's opinion is that interest rates will increase and that in one year, 4-year bonds will yield 5.0%. Assume for simplicity all the bonds and interest rates are zero coupon, estimate the return that will be earned on the 5-year bond over the next year if the manager is correct.
   A. 2.50%. 3.5%-4*(5%-4.75%)=2.5%
   B. 4.00%.
   C. 4.75%.
2. A high-net-worth investor has a $25 million bond portfolio with a modified duration of 10. He would like to decrease the duration of his portfolio to 8. Assume that bond futures contracts needed for adjusting this duration have a price value of a basis point (PVBP) of $50. What is the amount of futures contracts needed to buy or sell to lower this portfolio's duration?
   A. Sell 50 bond futures contracts.
   B. Sell 100 bond futures contracts.
   C. Buy 100 bond futures contracts.

MODULE 24.7: USING KEY RATE DURATIONS TO DETERMINE OPTIMAL STRATEGY

LOS 24.f: Evaluate a portfolio's sensitivity to a change in curve slope using key rate durations of the portfolio and its benchmark.

Video covering this content is available online.

CFA® Program Curriculum, Volume 4, page 147

Key rate durations (KRD) are also called **partial durations**. Like duration, they measure the sensitivity of change in value to yield change. Each KRD measures value change if only its one point on the yield curve shifts. Like duration, KRD can also be expressed as PVBP, sometimes called a **partial** or **partial key rate PVBP**. Summing a bond or portfolio's KRDs and partial PVBPs closely approximates the bond or portfolio total KRD and PVBP.

Key rate durations are calculated for a variety of maturities, such as 2 years, 5 years, 7 years, 10 years, 20 years, and 30 years. If, for example, the seven-year key rate duration of a bond is 5.65, a 1% increase in the seven-year yield will result in a 5.65% decrease in the value of the bond.

Given a set of expectations of changes in yields across maturities, key rate durations can be used to calculate the effect on portfolio value if those expectations are correct. An expected change in the curvature of the yield curve is an example of a situation where the use of key rate durations would be advantageous.

The change in yield expected in each segment of the yield curve can be multiplied by each segment's key rate duration (with a negative sign) for that segment, and then by the value of the bonds in each segment, to get the effect of the expected yield change for each segment of the curve on portfolio value. Summing these will provide the overall impact of the expected yield curve changes on the portfolio. We could also use the PVBP based on the key rates at each maturity to obtain the same result.

DURATION-NEUTRAL CURVE TRADES

LOS 24.h: Construct a duration-neutral government bond portfolio to profit from a change in yield curve curvature.

CFA® Program Curriculum, Volume 4, page 171

Consider three portfolios with the same duration of 7 constructed from three government bonds with durations of 3, 7, and 11.

- An equal weighted ladder of 3, 7, and 11 duration bonds.
- A bullet with only the 7 duration bond.
- An equal weighted barbell of the 3 and 11 duration bond.

PROFESSOR'S NOTE

Unless there are specific changes in rates provided, assume a steepening and flattening curve refer to equal magnitude, but opposing relative changes in the shorter and longer end of the curve. For example, a steepening could be 3, 7, and 11 duration bond yields increasing 0, 40, and 80 bp respectively. A flattening could be 3, 7, and 11 duration bond yields decreasing 0, 40, and 80 bp respectively.

- Steepening Curve: The bullet is the best with no exposure to the relative large increase in rates for the higher duration bond. The barbell is the worst with the greatest relative exposure to the large increase in rates for the higher duration bond. 长端受害大
- Flattening Curve: The barbell is the best with the greatest exposure to the relative large decrease in rates for the higher duration bond. The bullet is the worst with no exposure to the relative large decrease in rates for the higher duration bond. 长端受益大

Now consider an increase or decrease in bond curvature with the intermediate rate increasing or decreasing relative to the longer and shorter rate.

- Increasing curvature: The barbell is the best with no exposure to the relative increase in intermediate rates. The bullet is the worst with 100% exposure to the relative increase in intermediate rates. 中端无暴露
- Decreasing curvature: The bullet is the best with 100% exposure to the relative decrease in intermediate rates. The barbell is the worst with no exposure to the relative decrease in intermediate rates. 中段暴露大

Butterfly trades are a leveraged way to capture value when curvature changes. They involve taking a long and offsetting short position in the bullet and offsetting barbell. The short position funds the long position so no investor capital is required. The long and short duration cancel each other for a 0 net duration. Butterfly trades profit primarily from change in curvature.

A butterfly portfolio shorting intermediate-term bonds (borrowing at intermediate rates) and investing the proceeds in the barbell portfolio is like a super barbell. This can be called short the body (intermediate) and long the wings (barbell).

- It profits from increasing curvature.

- It also has net positive convexity and profits from high volatility. Recall the barbell with more disperse cash flow will have greater convexity than the concentrated cash flow short bullet position. Thus, long the barbell convexity less short the bullet convexity will be net positive convexity.

A butterfly portfolio shorting the barbell portfolio (borrowing at a combination of shorter and longer rates) and investing the proceeds in intermediate-term bonds is like a super bullet. This can be called short the wings and long the body.

- It profits from decreasing curvature.
- It also has net negative convexity and profits from having higher yield. Recall that in a rational market the compensation for giving up convexity is higher yield, all else the same.

Condor trades work the same and are evaluated the same as butterfly trades. The only modification is that two positions with relatively close duration are used for the bullet. For example, a super bullet butterfly could be constructed as long the 7 duration and short the 3 and 11 duration wings. A condor is similar but could use an equal weighted combination of long the 6.5 and 7.5 duration instead of a single long 7 duration position. The wings would remain as short the 3 and 11 duration.

MODULE QUIZ 24.7

To best evaluate your performance, enter your quiz answers online.

1. Which of the following statements regarding the use of key rate durations to evaluate a portfolio's sensitivity to yield curve changes is *least correct*?
   A. Key rate durations are often used with barbell and bullet strategies.
   B. Key rate durations are advantageous when there is a nonparallel shift in the yield curve.
   C. The sum of all key rate durations must be less than the effective duration of the bond or portfolio.
2. A manager must construct a portfolio using government bonds with durations of 3, 5, and 7. Her default portfolio is an equally weighted ladder of the three bonds with a portfolio duration of 5. She can also use bullet, barbell, and butterfly portfolios, as long as the duration is still 5. Her forecast is that intermediate-term (duration of 5) rates will increase relative to the shorter and longer ends of the yield curve. She would *most likely* conclude:
   A. a barbell portfolio will outperform the bullet.
   B. the greater convexity of the ladder will lead it to outperform the bullet.
   C. a butterfly portfolio long in the body and short in the wings will outperform the ladder.

MODULE 24.8: INTER-MARKET CURVE STRATEGIES AND CONCLUSION

LOS 24.g: Discuss inter-market curve strategies.

CFA® Program Curriculum, Volume 4, page 175

Video covering this content is available online.

A manager can examine multiple markets and expected changes in each curve to select the optimal strategy. Such strategies may also be constrained to zero duration and zero net cash invested long/short approaches. Basic inter-market strategies include:

- Using a swap with payments made in the portfolio's domestic currency. This will avoid currency risk. (Note: the swap rates will have embedded in them as if the currency risk were hedge in the forward currency market. That is why there is no currency risk.) For a swap based approach, you would generally:
    - Receive the rate at the end of a steeper segment of a yield curve. This would maximize initial yield and expected roll down return. (Alternatively, the manager can make some other set of assumptions to project and select the highest expected return.)
    - Pay floating based on the rate at a lower flatter segment of the yield curve.

  This would be a simple carry trade. If either or both rates are not based on the portfolio's domestic yield curve, this becomes an inter-market curve trade.

- Alternatively, use bond positions:
    - Buy a bond in one market at the end of a steeper segment of a yield curve to maximize initial yield and expected roll down return.
    - Short (borrow and pay the floating rate) in another market at a lower flatter segment of that yield curve.

  Such bond-based trades will earn the local market (RFC) return of each market and also be exposed to changes in value of the foreign currency/currencies. That currency risk and return (RFX) can be hedged in the forward currency market or left unhedged.

PROFESSOR'S NOTE

The CFA text includes ample warnings that inter-market trades can be very complex to analyze and that real world application can differ in details from what is presented in the CFA text. As the number of markets and points on the curve being considered are increased, the solutions can only be found using optimization software. Despite these caveats, the basic concepts you should know are covered in the following Inter-market Curve Trade example. You should also quickly see the optimal strategy depends on the assumptions made.

EXAMPLE 6: Inter-Market Curve Trade

A U.S.-based portfolio manager examines the following information regarding the yield curve in three markets. All yields are annualized and coupons are assumed to be semiannual.

	6 month LIBOR	1 year	3 year	5 year
U.S. (USD)	1.20%	1.40%	1.50%	1.50%
U.K. (GBP)	1.40%	1.80%	2.00%	2.10%
Germany (EUR)	–0.4%	0%	0.1%	0.2%

The manager expects the GBP and EUR to appreciate 1% and 0.75% respectively against the USD over the next 6 months.

A. For a USD-based portfolio, **state** which of the following unhedged currency carry trades will have the expected highest return for a 6-month holding period. **Show** your calculations. Assume any bonds trade at their initial YTM at the end of the 6-month holding period.

1. Buy the U.S. 3 year and borrow at the most appropriate German rate.
2. Buy the U.S. 5 year and borrow at the most appropriate U.S. rate.
3. Buy the U.K. 5 year and borrow at the most appropriate German rate.

B. For the same USD portfolio and using the same data the manager now considers duration and currency neutral long/short trades, **determine** the optimal trade. **Show** your calculations on an annualized basis. Again, assume any bonds trade at their initial YTM at the end of the holding period.

C. The manager now revises the assumptions regarding what will happen to the 5-year U.K. bond. It is projected interest rates in the U.K. will decline from the initial bond YTM of 2.1% and the 5-year bond (when it is a 4.5-year bond) will trade to yield 1.8%. It is initially a par bond with a coupon of 2.10, so its price 6 months later when it is a 4.5-year bond at a 1.8% YTM will be 101.29 (this can be calculated as: n = 2 × 4.5 = 9, FV = 100, PMT = 2.1 / 2 = 1.05, i/y = 1.8 / 2 = 0.9). All other factors are the same. **Calculate** the currency hedged and currency unhedged return of the three markets. Assume the only position is long the 5-year bond. You must calculate return for all three markets both with and without a currency hedged. Assume interest rate parity applies and determines the currency hedged position. **Show** your calculations for a 6-month holding period.

Answer:

A. The carry for #1 over half of a year is (1.5 – (–0.4)) / 2 = +0.95%. The best German borrowing rate is the lowest rate of –0.4%. However, the USD-based portfolio is short the EUR as the EUR borrowing must be repaid and will lose the 0.75% appreciation in the EUR. Currency change is a periodic projected return, not an annualized number. That makes the projected return +0.95 – 0.75 = 0.20%.

The carry for #2 over half of a year is (1.5 – (1.2)) / 2 = +0.15%. There is no currency exposure so that is the projected return.

The carry for #3 over half of a year is (2.1 – (-0.4)) / 2 = +1.25%. The best German borrowing rate is the lowest rate of –0.4%. However, the USD-based portfolio is short the EUR as the EUR borrowing must be repaid and will lose the 0.75% appreciation in the EUR. The portfolio is also long the GBP in the U.K. bond owned and will gain the appreciation in the GBP of 1.0%. That makes the projected return +1.25 – 0.75 + 1.0 = 1.50%.

Trade 3 is best at an expected return of 1.5%.

B. To be duration and currency neutral, the manager will buy at the longest point and sell at the shortest point of the steepest curve to maximize carry. Buy the U.K. 5 year at 2.1% and borrow at the U.K. 6-month rate of 1.4%. The carry is 70 bp. There is no net currency exposure with a long and short GBP position, but there is a net long duration position.

To neutralize duration exposure, buy at the shortest point and sell at the longest point of the flattest curve to minimize the carry lost while also netting to zero duration on the four positions. (Note that the CFA material is making the reasonable assumption that bonds with the same maturity but in different markets have the same duration.) The U.S. curve is the flattest at +30 bp so sell the U.S. 5 year at 1.5% and buy the U.S. 6 month at 1.2%

Net annualized carry is: +2.1 + 1.2% –1.4 – 1.5 = 0.4%. This question directed to work in annualized results.

C.

U.S.: With the bond continuing to trade at the initial YTM, half the initial YTM is the 6-month local market return: 1.5 / 2 = 0.75%. There is no currency return for a U.S. portfolio.

U.K.: Projected local market return is the 6-month coupon + ending price divided by beginning price: ((2.1 / 2) + 101.29) / 100 = 2.34%. If the currency is unhedged, it is assumed to appreciate 1.0% for a total return of 3.34%.

- The GBP with a higher 6-month interest rate of 1.4% versus the U.S. rate of 1.2% will trade at a forward discount. The periodic forward discount is (1.4 – 1.2) / 2 = 0.1%. The total currency hedged return will be 2.34 – 0.10 = 2.24%.

Germany: Projected local market return for 6 months is half the initial YTM = 0.2 / 2 = 0.1%. If the currency is unhedged, it is assumed to appreciate 0.75% for a total return of 0.85%.

- The EUR with a lower 6-month interest rate of –0.4% will trade at forward premium of (1.2 – (–0.4)) / 2 = 0.8. The total currency hedged return will be 0.85 + 0.8 = 1.65%.

PROFESSOR'S NOTE

An easy way to keep the forward premium or discount rate effect straight is that you lose the interest rate of the currency sold forward and gain the interest rate of the currency bought forward. That is not literally what happens, but it is mathematically correct when interest rate parity applies because the difference between the forward and spot exchange rates will reflect the difference in the two interest rates. The interest rates to use are the periodic rates that apply to the term to expiration of the forward.

Also the CFA text does include negative interest rates as you see in our discussion. We have illustrated how to handle such rates. The underlying mechanics are that:

- Paying a negative rate means receive that rate.
- Earning a negative rate means pay that rate.

EVALUATING EXPECTED RETURN FOR A YIELD CURVE STRATEGY

LOS 24.i: Evaluate the expected return and risks of a yield curve strategy.

CFA® Program Curriculum, Volume 4, page 197

A general framework for analyzing the effect of expected changes in the level, slope, and curvature of the yield curve can be developed by focusing on the three sources of portfolio return over a horizon period. A one-year analysis period is commonly used. Project the following:

1. Interest income.
2. The price returns from securities rolling down the current yield curve for one year.
3. The price returns from the expected (manager-predicted) changes in the yield curve.

In some cases, returns from exchange rate changes and the returns from changes in credit ratings must also be considered.

By summing these returns for securities in the benchmark portfolio and for those in a manager's portfolio and comparing them, we can estimate the relative performance of the manager's portfolio over the next year.

MODULE QUIZ 24.8

To best evaluate your performance, enter your quiz answers online.

1. A bond investor purchases a 10-year bond paying a 5% coupon rate on an annual basis with a current bond price of $100. Over the next year, the rolldown return from rolling down the yield curve to the expected yield curve is computed as 2.1%. In addition, the expected change in price based on the investor's yield view is 0.35%. What is the total expected return from this yield curve strategy?
   A. 6.75%.
   B. 7.10%.
   C. 7.45%.

2. A manager examines the yield curves in multiple countries and calculates the spread in each market between the 10-year and 6-month interest rate. Those spreads are:

	10-year – 6-month rate
U.S.	45 bp
Germany	77 bp
Japan	63 bp
Australia	81 bp

Which of the following is part of the *most likely* trade the manager will use to implement a duration and currency neutral long/short trade?

A. Buy a German 10-year bond.
B. Enter a 10-year swap to pay the U.S. fixed rate.
C. Short the Japanese 10-year bond.

KEY CONCEPTS

LOS 24.a

Active Strategies When the (Upward Sloping) Yield Curve Is Expected to Be Stable

- Buy and hold—extend duration to get higher yields.
- Roll down the yield curve—portfolio weighting highest for securities at the long end of the steepest yield curve segments, maximizes price gains on securities from declines in yield as time passes.
- Carry trade—borrow at lower rates to purchase securities with higher rates.
- Sell convexity—reduce portfolio convexity to increase yield.

Active Strategies for Anticipated Changes in Yield Curve Level, Slope, or Curvature

- Duration management—increase (decrease) portfolio duration if rates are expected to decrease (increase).
- For nonparallel shifts in the curve—increase (decrease) portfolio exposure to key rate durations where relative decreases (increases) in key rates are expected.
- Buy convexity—increase portfolio convexity; decreases yield but improves price performance for larger changes in rates.
- Bullet and barbell structures—security durations are concentrated around portfolio duration (bullet) or concentrated at the ends of the yield curve (barbell). Barbells tend to have higher convexity but lower yield and tend to outperform if curvature increases.

LOS 24.b

To execute a carry trade in an upward sloping yield curve:

- Borrow at shorter-term lower rates and invest at longer-term higher rates.
- Enter a swap to pay fixed versus receive floating.

For a basic cross-border carry trade with a duration mismatch:

- Borrow in a lower interest rate currency to invest in a higher interest rate currency, keeping duration the same in both markets. (Note there is still a risk the interest rate changes in the two positions could differ even though the durations are the same.)
- Use a currency swap to pay the lower rate and receive the higher rate.

LOS 24.c

Convexity matters more for larger changes in rates. When a manager is correct in expecting yield volatility to be greater (less) than current market expectations, increasing (deceasing) portfolio convexity will improve portfolio performance.

Portfolio convexity can be increased (decreased) by shifting to a barbell (bullet) strategy by buying (selling) call options on bonds. Convexity can also be decreased by replacing straight bonds with MBSs and callable bonds to increase yield.

LOS 24.d

To select the optimal bond off the yield curve:

- Project ending (manager's projected) yield of each point on the curve and use the ending yield of each bond to project its ending price.
- Project holding period return as the percent change in price + coupon yield.
- This is pure active management; select the bond with highest projected holding period return.

Projected holding period return for each bond can be approximated as:

(–ending effective D × manager's forecasted change in YTM) + beginning YTM

Comparing the manager's forecast of YTM to the implied forward rate is also useful. When the manager's forecast is:

- Lower, the bond will outperform.
- Higher, the bond will underperform.

LOS 24.e

Price value of a basis point (PVBP) = 0.0001 × duration × portfolio value. PVBP may be divided by 100 for PVBP per hundred of portfolio value.

Portfolio duration can be increased by adding bond futures to the portfolio.

$$\text{number of futures contracts to buy} = \frac{\text{target portfolio PVBP} - \text{current portfolio PVBP}}{\text{PVBP futures contract}}$$

Taking the pay-floating side of an interest rate swap increases duration. It is equivalent to borrowing at a short-term rate and buying fixed-rate bonds.

Adding bond call options to a portfolio will increase both its duration and convexity.

Convexity can be decreased by selling bond calls or by replacing portfolio bonds with MBSs because the embedded prepayment option in MBSs gives them negative convexity.

LOS 24.f

Key rate durations are similar to duration, but measure expected price change if only one point on the yield curve changes. The effect of expected change in the slope or curvature of the yield curve can be modeled using key rate durations. Multiply each key rate duration by expected change in each key interest rate by portfolio value at each key interest rate. The sum of these calculations is the expected change in value of the portfolio. The manager can repeat this exercise for different portfolio compositions and then implement the composition with the best expected return.

LOS 24.g

Inter-market carry trades can be implemented by:

- Borrowing in a lower interest rate currency to invest in a higher interest rate currency.
- Using a currency swap to pay that lower rate and receive that higher rate.
- In the market with higher rates, borrowing at shorter lower rate end of the curve to invest at the longer higher rate end of the curve. Plus, enter an FX swap to receive the same shorter-term rate (being paid on the borrowing) versus pay the rate of a lower interest rate currency.

To avoid having a currency risk exposure on the inter-market trade:

- Use swaps and enter a receive fixed versus pay floating in the steeper yield curve market. Plus, enter an offsetting swap to receive floating versus pay fixed in the flatter yield curve market.
- Use bonds to replicate the economic exposures of the four positions taken with the two swaps.
- Buy bond futures in the steeper curve market and sell note futures in the flatter curve market. (If the contracts settle in the investor’s currency, there is no currency exposure.)

LOS 24.h

These strategies presume portfolio duration is kept the same. To increase portfolio return when yield curve curvature will:

- Increase, use a barbell strategy.
  - A butterfly portfolio, short intermediate-term bonds and long the barbell will be even better.
- Decrease, use a bullet strategy.
  - A butterfly portfolio, short the barbell and long intermediate-term bonds will be even better.

LOS 24.i

A general framework for analyzing the effect of expected changes in the level, slope, and curvature of the yield curve focuses on projecting three sources of portfolio return over an analysis period. A one-year horizon analysis is common. Project the following:

1. Interest income.
2. The price returns from securities rolling down the current yield curve for one year.
3. The price returns from the expected (manager-predicted) changes in the yield curve.

Repeat the process for both the portfolio and benchmark; the difference in the two projected returns is the expected value added by active management.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 24.1, 24.2, 24.3, 24.4

1. **A** This is a barbell strategy of overweighting short and long maturities while reducing holdings in middle maturity securities, relative to the benchmark portfolio. The higher duration of longer securities will produce large relative gains in value if longer-term rates decline. A flattening curve is the best environment for a barbell. A yield curve flattens when long maturity yields decline relative to short maturity yields. (Module 24.2, LOS 24.a)

2. **A** Portfolio convexity can be increased by shifting to higher convexity securities relative to those in the benchmark portfolio. Alternatively, a manager can increase the portfolio weights at both the long and short ends of the yield curve (a barbell strategy). One way to decrease portfolio convexity is to sell calls on portfolio bonds and sell puts on bonds that the manager would like to own. (Module 24.3, LOS 24.c)

3. **A** The 5-year swap has curve risk with a 5-year rate versus a floating 6-month rate. That is yield curve risk. One side of the swap is in JPY so there is currency risk for the U.S. investor.

   The 7-year swap is fixed for fixed (and both fixed rates will reflect the 7-year term of the swap) so there is not yield curve risk. Note that the 7-year rates in the two countries could change by differing amounts, but that is considered a spread risk and not a duration mismatch (curve position) risk.

   The 6-year bond trade is also fixed for fixed, so no yield curve risk, though again there is spread change risk. (Module 24.4, LOS 24.b)

Module Quiz 24.5, 24.6

1. **A** If implied forward rates occur, all bonds will earn the same return over the forward period being analyzed. In this case, that period is one year, so the return will equal the return of today's one year bond (i.e., 3.5%). The manager projects the yield of today's 5-year bond when it is a 4-year bond will be 5% and not the implied forward rate of 4.75. This 25 bp higher rate will reduce the bond's return. It will then have a duration of approximately 4, so the return reduction is 25 × 4 = 100 bp. That makes the projected return approximately 3.5 – 1.0 = 2.5%. (Module 24.5, LOS 24.d)

2. **B** The PVBP of the current portfolio (duration of 10) is 0.0001 × modified duration × portfolio value = 0.0001 × 10 × 25 million = $25,000.

   The PVBP of the adjusted portfolio (duration of 8) is 0.0001 × 8 × 25 million = $20,000.

Therefore, we need to sell: $5,000 / $50 = 100 bond futures contracts to decrease the bond PVBP from $25,000 to $20,000. (Module 24.6, LOS 24.e)

Module Quiz 24.7

1. **C** The sum of all key rate durations must be approximately equal to the effective duration of the bond or portfolio. Key rate durations are often used to identify barbell and bullet strategies. An expected change in the curvature of the yield curve is an example of a situation where the use of key rate durations would be advantageous. (LOS 24.f)

2. **A** The barbell will have no exposure to the 5 duration where rates are relatively increasing. It should outperform the bullet, which is all 5 duration.

   While it is true the ladder will have more convexity than the bullet, that is only a benefit for large changes in the overall level of rates. This is not the forecast. The ladder will have less exposure to the 5 duration and will outperform the bullet due to the forecast reshaping; but in this case, it is not convexity that would lead the ladder to outperform the bullet. A butterfly can be used, but the one offered is precisely the wrong butterfly. Going long in the body creates relative losses when the 5 duration rate relatively increases, and going short in the wings creates more relative losses when the 3 and 7 duration rates relatively decrease. Remember, rates up, price down, which is a loss to a short position. Note that a butterfly of short the body and long the wings is likely the optimal strategy in this environment. (LOS 24.h)

Module Quiz 24.8

1. **A** Expected return can be computed as yield income + rolldown return + E(change in price based on yield view). Yield income is computed as annual coupon payment / current bond price. Therefore, the total expected return = 5 / 100 + 2.1% – 0.35% = 5% + 2.1% – 0.35% = 6.75%. (LOS 24.i)

2. **B** To maximize the expected profit of this cross-border carry trade, the manager will do the following: buy the Australian bond and finance at 6-month Australian rates (Australia, at 81 bp, has the steepest curve), while selling the U.S. bond and invest at the 6-month U.S. rate (the U.S., at 45 bp, has the flattest curve). The manager is net long and short each currency, as well as long and short the 6-month and 10-year points on the curves. The expected return is +81 – 45 = 36 bp.

   Buying a German bond is not part of the strategy. Neither is shorting a Japanese bond. However, a 10-year swap to pay the U.S. fixed rate is economically equivalent to shorting (or borrowing) at the 10-year U.S. rate and that is part of the strategy. (LOS 24.g)

The following is a review of the Fixed-Income Portfolio Management (2) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #25.

READING 25: FIXED-INCOME ACTIVE MANAGEMENT: CREDIT STRATEGIES

Study Session 12

EXAM FOCUS

Last, we turn to ways to add value by altering exposure to credit risky positions.

MODULE 25.1: IG VS. HY AND MEASURING SPREAD

Video covering this content is available online.

The *credit market* refers to all securities where credit risk is an important issue. High-quality government bonds from well-developed countries are generally assumed to have no credit risk and are excluded from the credit portfolio. The remaining credit risky instruments may be public or private issues. Publicly traded issues include corporate bonds, other sovereign, and non-sovereign government and supranational (international agencies with powers delegated by governments) bonds as well as money market instruments such as commercial paper. Non-public issues include loans and private placements. Structured instruments such as mortgage and asset-backed securities and collateralized debt obligations may be public or private.

Investment-grade (IG) bonds are defined as ratings above BB. These would be Moody's investment ratings of Aaa to Baa3. Standard & Poor's and Fitch use AAA to BBB-. Such bonds generally have lower credit and default risk as well as lower yield and yield spread.

High-yield (HY) bonds are all bonds rated below investment-grade. They are also called *speculative grade* or *junk bonds*.

Although the public rating agencies are a good starting point for credit analysis, individual analysts normally make their own assessments and may reach different conclusions. Even so, the portfolio constraints often specify minimum credit quality requirements, based on the public ratings. In particular, many portfolios are prohibited from owning below investment grade bonds.

Both the rating agencies and analysts typically follow a similar approach to credit evaluation, assessing the four Cs. These are *capacity* to pay, *collateral* that can be claimed if the bonds default, *covenants* that restrict the actions of the issuer, and *character*, which is the quality and integrity of the issuer. The *capital* behind the issuer may be considered a fifth C.

LOS 25.a: Describe risk considerations in investment-grade and high-yield corporate bond portfolios.

CFA® Program Curriculum, Volume 4, page 234

The specific forms of risk exposures in any specific bond can vary substantially. The major risks are the following:

Credit risk is narrowly defined here as loss caused by a counterparty's or debtor's failure to pay. It has two components: **default risk** and **loss severity** (or **loss given default**). Default risk is the probability that an issuer will not make timely payment of principal and interest, and loss severity is the percent of par not paid if there is a default. For example, if a group of bonds has an annual 2% probability of default and a 40% loss severity, the annual credit risk loss estimate would be $0.02 \times 0.40 = 0.8\%$.

Spread risk refers to decline in price relative to credit risk free bonds due to spread widening. **Credit migration risk** refers to the risk a bond can decline in credit quality and bond rating. It should be obvious that these terms are interrelated; as credit quality declines, rating is likely to decline, spread is likely to widen with probability of default and likely losses increasing.

Credit risk is often used as a broad term to refer to all of these issues. Recall some earlier formulas that indicate why general interest rate and spread change are important:

- $\%\Delta$ value $= -\text{MD}\ \Delta y$
- $\%\Delta$ relative value $= -D_S\ \Delta s$
- spread $= y_{\text{higher yield}} - y_{\text{government}}$

Analysts and managers generally use interest rate risk to refer to changes in default-free (risk-free) government bond yields that are used as the reference rates to determine spread. An option-free bond's modified duration measures its change to general interest rate movement while its **spread duration** measures its price change if only spread (due to credit risk) has changed. The two concepts allow decomposing two sources of change in a bond's price as its yield changes due to risk-free rate and spread change.

For most bonds, modified duration and spread duration are the same. The important exception is floating rate securities, which have little duration but can have high spread duration. Consider an issuer with a 10-year fixed coupon bond and a 10-year floating rate bond.

- The 10-year fixed coupon bond has modified and spread duration of 9.1. If either risk-free rates or spread increase by 20 bp, the bond's price is expected to decline 1.82%. The effect is the same because future cash flows of the bond are fixed, regardless of why the yield changed.
- The 10-year floating rate bond has modified and spread duration of 0.25 and 9.1 respectively. If risk-free rates increase by 20 bp, the bond's price is expected to decline only 0.05%. The price is insensitive to the rate change because the future coupons adjust upward with the rate increase. (The duration is tied to the next coupon reset date when the bond should trade at par as the coupon rate adjusts.) In contrast, if spread increases by 20 bp, the bond's price is expected to decline 1.82%. The reason is the coupons only adjust for general change in rates and not

for specific spread change related to this issuer. The coupon spread can only be renegotiated when the bond matures, so spread duration is tied to final maturity, not coupon reset.

In theory, IG and HY would respond similarly to credit and interest rate risk, but in practice their sensitivity is quite different. The different behavior is due to a large differential between the credit risk and spread of IG versus HY, and a generally negative correlation between risk-free rates and spread.

- In a study by Moody's covering 1983 to 2015, annual credit losses in IG were only 0.06% versus 2.55% for HY. The annual loss in IG ranged between 0.00% and 0.42%. For HY, the annual loss range was between 0.42% and 7.61%.
- Because spread reflects compensation for taking credit risk, the much higher credit risk in HY is reflected in much higher spread. In a Barclays Capital study covering 2001 to 2015, spread for IG was typically well below 200 bp, spiking to +400 bp in the 2008 to 2009 financial crisis. In contrast, spread for HY was much higher and more volatile, reaching a low of 200 bp in 2007 and a high of over 1600 bp in the financial crisis.

It has also been observed that risk-free rates and spread often move in opposite directions (i.e., are negatively correlated). This makes sense because stronger economic conditions often lead to increasing risk-free rates but decreasing risk of default, increasing credit ratings, and lower spreads. The lower spreads increase bond price. Weaker economic conditions often lead to decreasing risk-free rates but increasing risk of default, decreasing credit ratings, and wider spreads. The higher spreads decrease bond prices. This canceling effect is most pronounced for HY, and as a result, their price change is driven more by spread change than the changes in risk-free interest rates.

This effect is captured in differences between effective and empirical duration.

- Effective duration is based on how the PV of a bond's future cash flows (i.e., its price) should change as the bond's yield (i.e., discount rate applied to the future cash flows) changes. For option free bonds, this is the modified duration. For bonds with embedded option, it is option adjusted duration that takes into account the most likely future cash flows of the bond.
- **Empirical duration** is based on regression of actual bond price and interest rate changes.

A Barclays Capital and Wellington Management study showed the two measures are not equal and the difference was most pronounced for HY bonds.

- For IG, the empirical durations were lower than effective durations and the difference increased moving down in credit rating from Aaa to Baa.
- For HY, the differences increased dramatically with empirical duration near 0 for Ba and B rated bonds. For Caa rated bonds empirical duration was negative. That means that a general increase in interest (risk-free) rates was associated with such large declines in spread that the yield on such bonds declines and their prices increased as other interest rates increased and other bond prices declined.

The conclusions are that the IG investors are primarily exposed to interest rate risk, with secondary exposure to credit and spread risk. In contrast, HY investors face little interest rate risk (as measured by modified or effective duration) but are much more exposed to credit and spread risk. Despite the general conclusions, both groups need to be aware of both risks. For example, IG investors who fail to broadly diversify credit risk could be exposed to significant credit risk if one holding defaults or experiences spread widening. The HY investor needs to recall that the general observation of spread and interest rate changes offsetting is not an absolute relationship and does not hold in all periods. For example, if spreads were already narrow and the economy continues to improve, spread is unlikely to change any more and risk-free rates are likely to increase, causing both IG and HY bond yield to increase and price to decrease.

Liquidity risk is generally defined as the ability to buy or sell quickly at near fair market value. Liquidity and trading risks in IG and HY differ and all of the relevant factors indicate more risk for HY. Those factors include the following:

- Bid-ask spread is wider for HY because the size of the bond issues and overall market is smaller.
- Regulatory and risk management issues are greater for HY, resulting in dealers being less willing to hold HY positions in inventory.

As a result, it is more costly to trade and therefore turnover is lower in HY portfolios. This also affects starting new portfolios. A manager with existing HY portfolios who starts a new portfolio is often unable to replicate the same existing holdings and must find substitute bonds. This is also true for IG portfolios, but to a lesser degree.

These differences affect how bond prices are quoted. The price for an IG bond is normally given as a spread to benchmark government bonds. For example, the bond is offered at the Treasury yield +75 bp. That YTM is then converted to price paid. In contrast HY bonds are generally quoted as a price [e.g., 97.50 (per 100 par)].

CREDIT SPREAD MEASURES

LOS 25.b: Compare the use of credit spread measures in portfolio construction.

CFA® Program Curriculum, Volume 4, page 242

As already discussed, bond price change can be differentiated into change due to general changes in interest rates (risk-free rates) and credit spread change. There are several ways to measure credit spread.

Benchmark spread is the difference in YTM of a bond and a similar duration credit risk-free benchmark bond. The on-the-run government bond is typically used. Generally, there are only a limited number of such government bonds and a straight line interpolation of YTM is made between the two closest bracketing duration government bonds. That interpolated yield is used as the benchmark and the resulting spread is called the **G-spread**. The G-spread is useful because it directly reflects how to hedge the interest rate risk and retain the credit spread of the bond. It is not useful when the bonds have embedded options.

EXAMPLE: G-spread

A manager gathers the following information on three bonds. He plans to buy 1 million par of the corporate bond.

	Price	Yield (YTM)	Maturity	Effective D
7-year corporate bond	101.50	3.77%	6.7	6.1
5-year government bond	99.96	1.90%	4.9	4.7
7-year government bond	99.56	2.20%	7.0	6.5

The manager is aware that there is some controversy in the industry regarding whether it is best to compute G-spread by matching maturity or duration. Maturity has often been used and is regarded as simpler. Some theoretical arguments favor an interpolation based on duration as more accurate. The analyst has determined the difference in the two methods is not generally large and favors the more traditional “use maturity” approach.

1. **Calculate** the initial benchmark (G-spread) of the corporate bond based on interpolated maturity matching.
2. **Calculate** the hedge position to eliminate interest rate risk for the 1 million par of the corporate bond and **calculate** the expected return on the hedged position.

   After buying the corporate bond, the yield of the 5- and 7-year government bonds increase 10 and 15 bp respectively, while the corporate bond’s yield declines 3 bp.
3. **Estimate** the new price of the corporate bond.

Answers:

1. Determine the weight of the two government bonds; the weight in the 5-year government bond is denoted as w:

   6.7 = w(4.9) + (1 – w)(7.0)

   6.7 = 4.9w – 7.0w + 7.0

   0.3 = 2.1w

   w = 14.3% in 5-year government bond and 85.7% in 7-year government bond

   That makes the benchmark yield: 0.143(1.90%) + 0.857(2.20%) = 2.16% and spread: 3.77 – 2.16 = 1.61%
2. Cost of the purchase is 1 million × 101.50 / 100 = 1,015,000.

   Short the 5-year and 7-year government bonds (market value amount) equal to 14.3% and 85.7% of 1,015,000 respectively.

   Expected return: yield purchased – yield shorted = 3.77 – 2.16 = 1.61%
3. Expected change in benchmark yield = 0.143(10) + 0.857(15) = +14.3 bp

   Expected change in corporate bond yield = 14.3 – 3bp = +11.3bp

   Estimated price change of corporate = –6.1(0.00113) = –0.0069 = –0.69%

   Estimated new price: (1 – 0.0069)(101.50) = 100.80

The **I-spread** is computed and used the same way as the G-spread but is based on swap fixed rates as the benchmark yields. The advantages are a smoother yield curve because swap fixed rates (SFR) are quoted for many different maturities compared to only a few on-the-run government yields. There can be disadvantages. First, spread is intended to be a comparison to a credit risk free benchmark rate. SFRs normally reflect very high quality (but not fully credit risk free) rates. Under normal economic conditions the SFR serves as a reasonable proxy for risk free, but in periods of crisis this may not hold. Second, SFRs are not the same as government bond yields and so I- and G-spread are not identical. When government bonds are used to hedge the interest rate risk, I-spread will not directly measure the expected hedged return.

Benchmark, G-spread, and I-spread are all forms of nominal spread and differences in YTMs. When there are embedded option features they are misleading and other spread measures are needed.

Z-spread (zero-volatility spread) is a trial and error calculation to determine a single spread that if added to the implied initial spot rate curve of credit risk-free bonds could then be used to discount the bond's future cash flows to its current market value. While it is based on on-the-spot rate curve instead of a single YTM benchmark, it still does not consider embedded option features. If there are no embedded options, Z-spread will closely approximate the other nominal spread measures.

OAS (option adjusted spread) is a more complex derivative of Z-spread and does reflect the impact of options on expected return. It explicitly requires an assumption of interest rate volatility to build an interest rate tree of possible forward interest rates. Future cash flows are based on these possible future interest rates. The OAS is then a trial and error calculation to determine a single spread that if added to every node of the interest rate tree of credit-risk-free bonds would discount the bond's future cash flows to its current market value. It is the expected average incremental return that would be earned if the interest rate risk of the bond were hedged, assuming no defaults. OAS is the most widely used measure of incremental return for credit risk but it can be misleading because it measures a simulated *average result*. In any one time period, rates will follow a single path, the option will or will not be exercised, and actual results can be (considerably) higher or lower than the OAS (average).

When a portfolio includes bonds both with and without embedded options, market value weighted average OAS is the best measure of credit exposure. If there are no embedded options, market value weighted average of the other spread measures is sufficient.

Credit spread can be viewed as incremental return above the benchmark used in calculating the spread. If spread is not expected to change, the excess return (XR) is approximately the spread (s) earned over the projected time period (t). In more complex situations a change in spread (Δs) and spread duration (SD) are also relevant. Spread widening (narrowing) leads to reduced (increased) performance due to relative price decline (increase) by the spread assets. This approach can be further expanded to incorporate loss in excess return due to probability of default (p) and severity of loss (L) during the time period. Because credit default is binary (it happens or does not) when default loss estimates are included it is common to refer to the excess as estimated excess return (EXR). Annualized data are normally used in these calculations.

$$\text{XR or EXR} = (s \times t) - (\Delta s \times SD) - (t \times p \times L)$$

EXAMPLE: Using credit spread data

A manager has collected data on both a bullet (no embedded options), callable, and putable bond of the same issuer. The bonds are similar in all other regards.

Bond	A	B	C
G-spread	425	423	426
I-spread	429	426	429
Z-spread	435	434	434
OAS	351	503	434
Price	95.00	97.00	99.00
Accrued interest, per 100 par	0.60	1.10	0.75

1. Based on the data provided, **determine** which bond is most likely option free and **explain** why.
2. **Determine** which bond is most likely the putable bond and **explain** why its OAS is similar to, higher, or lower than it's Z-spread. Your answer must also **discuss** direction in interest rate movement that would make the put feature relevant.
3. If 3 and 2 million par of bond A and C are purchased, **calculate** the most relevant measure of portfolio spread.

Answers:

1. Bond C, with no embedded option, Z-spread and OAS should be the same.
2. Bond B, the OAS exceeds the Z-spread because it captures the potentially favorable impact of the put feature on the investor's return. If rates increase, the investor can redeem the bond early and reinvest at those higher rates, increasing the return earned. Said another way, the put price establishes a floor on the value of the bond and increases the investor's return if rates increase.
3. Because bonds with embedded options are being used, OAS is the best spread measure. Market weights are needed to compute the portfolio spread and full price with accrued interest should be used). For example for bond A, 95 + 0.60 = 95.60.

   Market value A = (3,000,000 / 100) × (95.60) = 2,868,000; w = 59.0%

   Market value C = (2,000,000 / 100) × (99.75) = 1,995,000; w = 41.0%

   Portfolio market value = 4,863,000

   Portfolio OAS = 0.590(351) + 0.410(434) = 385 bp

MODULE QUIZ 25.1

To best evaluate your performance, enter your quiz answers online.

1. A manager is considering the addition of investment-grade bonds and high-yield corporate bonds into one of his client's portfolios. The client expressed interest in gaining exposure specifically to investment-grade bonds, but not to high-yield bonds due to risk concerns. What is the primary risk exposure for investment-grade bonds?
   A. Credit risk.

B. Spread risk.
C. Interest rate risk.

2. Assume a bond portfolio contains a collection of bonds with embedded options and bonds without embedded options. Which type of spread measure would be *most suitable* for measuring the credit exposure of this portfolio?
A. I-spread.
B. G-spread.
C. Option-adjusted spread.

MODULE 25.2: TOP-DOWN AND BOTTOM-UP

LOS 25.c: Discuss bottom-up approaches to credit strategies.

LOS 25.d: Discuss top-down approaches to credit strategies.

Video covering this content is available online.

CFA® Program Curriculum, Volume 4, pages 248 and 257

Either approach or a combination of both can be used to manage a credit portfolio.

- It may be easier to gain an information advantage with bottom-up because the manager can focus on only the least efficient sectors of the market to identify individual over- or undervalued securities. Bottom-up analysis works best when comparing bonds with fairly homogeneous credit risk exposure; such as within IG or HY. The problem is macro factors such as portfolio duration and interest rate change can overwhelm value added with individual security valuation changes.
- Top down has an advantage in that it focuses directly on those macro factors that drive interest rates, average credit spreads, and default losses. The problem is these same factors are examined by many others and it may be harder to gain an information advantage.
- To combine approaches, the bottom-up manager can build the portfolio by overweighting undervalued and underweighting overvalued securities; then monitor and adjust as needed for the macro factor risk exposures such as duration (interest rate risk) and portfolio credit risk. The top-down manager can begin with macro factors to identify the most attractive sectors of the bond market and then use individual security analysis within those sectors.

BOTTOM-UP IN DETAIL

The bottom-up manager would start with identifying the universe of bonds to consider, then divide that universe into sectors such as auto-related and mortgage-backed securities (MBS). Typically the manager is being measured against a benchmark and would match benchmark weights but over- or underweight individual securities or issuers. The manager should determine if the sector divisions in the benchmark are reasonable. For example, the manager may believe MBS is too broad a sector and differentiating government versus privately backed MBS will reveal important differences in risk or expected return.

The manager then looks for relative misvaluation within each sector to determine individual securities to select. The evaluation must weigh compensation (expected excess return) versus credit risks (credit spread, credit migration, default, and liquidity risks). For example:

- A manager views bond D and E as having similar credit risk exposures, but D has a higher spread and expected excess return; he would select D.
- A different manager believes D has higher credit risk than E, but given its higher spread she is indifferent between the two bonds.

Gathering information to assess the credit risks is critical. This can include historical default rates (p) and loss rates (L) as well as charting past spread relationships. For example, a particular auto company's bonds trade at spreads that are wider than the issuer's average and wider than other auto companies. As long as the analyst is convinced there are no unaccounted for risk differences, overweight that company's bonds.

The previous excess return model can be used in this analysis:

$$XR = (s \times t) - (\Delta s \times SD) - (t \times p \times L).$$

Assuming the analyst does not expect spreads to change, this issue becomes comparing the incremental spread earned versus estimated default losses. This is complicated because the factors are interrelated; bonds with higher expected default losses (a negative) usually have higher spread (a positive). Typically, the manager will select the bonds with highest XR but there are exceptions to this. The portfolio may already be overweighted in that issuer and need to diversify into less attractive XR bonds. The manager may also need to select bonds with lower XR to emphasize high liquidity or to meet an overall portfolio duration constraint.

EXAMPLE: Selecting bonds based on relative value

A manager gathers information on three bonds. She plans to purchase one of the bonds and anticipates a 9-month holding period.

Bond	Spread Duration	Yield %	Z-spread bp	Credit rating	Est. default rate based on rating	Bid ask spread	Projected Liquidity
1	7	5.50	350	B	3.59%	6/32	Low
2	6	3.70	150	Aa	0.22%	4/32	High
3	3	3.60	200	A	0.34%	4/32	High

All the bonds are recent issues and available for purchase at the yield stated in the table. Default rates are annualized and based on historical data for similarly rated bonds. She assumes 30% of par value will be recovered in any default. Liquidity is based on the manager's estimate of ability to buy or sell at reasonable cost and is projected liquidity 3 months from now and once the bonds are fully placed with long term investors.

1. **Recommend** the best bond based on expected excess return and assuming no change in spread. **Show** your calculations.

2. **Recommend** the best bond based on expected excess return and assuming all spreads narrow (decline) by 60 bp. **Show** your calculations.
3. **Explain** conceptually (no calculations) how rating, bid ask, and liquidity would affect this manager's decision process. **Discuss** *each* item individually.

Answers:

1. Bond 1: 3.50(.75) − 0(7) − 0.75(3.59)(0.70) = 2.625 − 0 − 1.885 = +0.740%

   Bond 2: 1.50(.75) – 0(6) – 0.75(0.22)(0.70) = 1.125 – 0 – 0.116 = +1.009%

   Bond 3: 2.00(.75) – 0(3) – 0.75(0.34)(0.70) = 1.500 – 0 – 0.179 = +1.321%

   Select bond 3.

   Note that the data was given in a mixture of bp and percent. All relevant data must be in the same units. Percent data was used in the solution. And 30% was given as the recovery rate; that is why 0.70 was used as the loss severity.
2. Bond 1: 3.50(.75) − (–0.6)(7) − 0.75(3.59)(0.70) = 2.625 + 4.200 − 1.885 = +4.940%

   Bond 2: 1.50(.75) – (–0.6)(6) – 0.75(0.22)(0.70) = 1.125 +3.600 – 0.116 =

   4.609%

   Bond 3: 2.00(.75) – (–0.6)(3) – 0.75(0.34)(0.70) = 1.500 +1.800 – 0.179=

   3.121%

   Select bond 1.
3. Rating: Bond 1 is well below investment grade so the manager should verify it is consistent with account constraints

   Bid-ask is not relevant because the facts state all the bonds can be purchased at the YTM stated in the table and used in the evaluation.

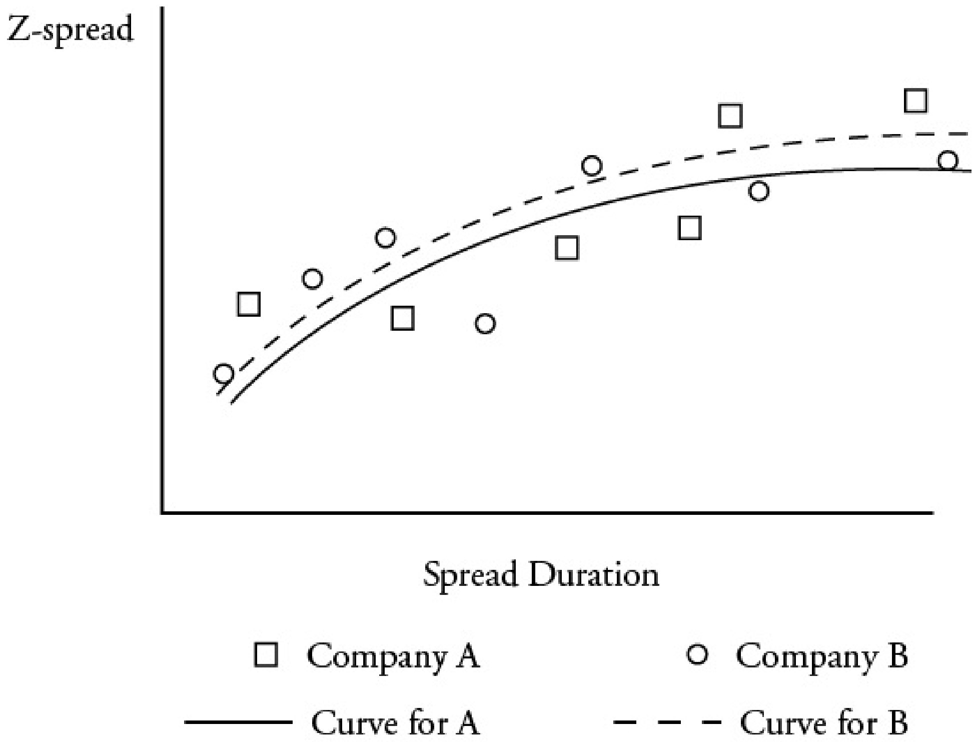
   Liquidity: Bond 1 becomes less attractive based on the 9-month holding period because it may be more costly to sell at the end of the period.

   Note that the information does not allow any final conclusions. That is why you were only asked to explain conceptually. You can make other comments if they are based on the reading and are equally relevant to this situation.

Spread Curves

Spread curves are another useful bottoms up tool. Figure 25.1 provides an example of how to use such curves.

Figure 25.1: Spread Curve for Two Companies



Based on Figure 25.1:

- In general, bonds of company B offer slightly higher spread. Assuming the two issuers are equal in all other regards, the B bonds offer better excess return and are more attractive.
- Both issuers have several available issues. Any specific bond issue that plots above (or below) the issuer's curve is potentially more attractive (or unattractive) for purchase.
- These are tentative conclusions and the bonds should be examined carefully for other considerations such as differences in:
    - Liquidity.
    - Date of issuance; older issues are generally less liquid.
    - Pending new supply; if the issuer is about to issue a new security of similar remaining maturity the older issue is likely to decline in liquidity.
    - Seniority in bankruptcy; subordinated debt is likely to experience greater loss (less recovery) in bankruptcy.
    - Size of issue and total issuance outstanding by issuer; generally larger individual issues and total issuance make it economical for more investors to analyze and follow the bonds. Therefore, the increased issuance is often associated with better liquidity and higher bond prices. However, there can be too much supply of a given issue and issuer, leading to the opposite effect. The supply may saturate the market demand, leading to less liquidity, wider bid-ask, and higher credit spreads. Excessive issuance could also be associated with too much leverage and declining credit quality.

Practical Considerations

Final credit portfolio construction involves identifying the optimal risk exposures and best relative value holdings, and is likely to involve compromise.

- In specifying exposure to credit risk, the manager should consider both spread duration and market value allocation.
  - Spread duration measures expected percent change in value from spread change. For example, if bond A has a spread duration of 3 and is 4% of the portfolio, its duration contribution is 3(0.04) = 0.12. If a similar issuer's bond has a spread duration of 6 and is 2% of the portfolio, its duration contribution is also 0.12. If the spread of both bonds widens by 100 bp, the effect on total portfolio value is the same: –3(0.04)(0.01) = –6(0.02)(0.01) = portfolio decline of 0.12% in value. Generally, for investment grade bonds and when default is not expected to be a significant factor, sensitivity of the portfolio to spread change is the most relevant measure of spread risk. This is best measured by SD and duration contribution.
  - In contrast, for HY and bonds where default risk is high, market value allocation is the more relevant measure of credit risk. Consider a simple example in which recovery for default is expected to be 0% and the loss 100%, bond A is twice as risky because the portfolio holds—and can therefore lose—twice as much.
- The manager must also be prepared to compromise in selecting best relative value. The first, second, or even third choice bond may turn out to be unavailable for purchase. The manager can:
  - Move down his relative value list and find the best available substitute bond.
  - Temporarily invest in a suitable index fund (or use swaps or other derivatives to replicate such exposure) until the desired bonds are available.
  - Temporarily hold cash and not have the desired bond market exposure until the desired bonds are available.

TOP-DOWN IN DETAIL

LOS 25.d: Discuss top-down approaches to credit strategies.

CFA® Program Curriculum, Volume 4, page 257

The top-down approach focuses on macro factors that are likely to affect the credit portfolio. Relevant factors include strength of economic growth and corporate profits. Stronger growth and profits are associated with decreasing spread and suggest moving down in credit quality for greater relative price gains. Top-down managers may use this relationship to identify when to focus on HY versus IG.

Top-down can also be used to identify sectors of the market most likely to improve (or deteriorate) and the manager can overweight (or underweight) those sectors. This analysis could also be used by the bottom-up manager to identify sectors for more targeted individual security analysis.

Top-down may focus on historical patterns such as the credit cycle and credit spread change. The credit cycle refers to variations in real economic growth and default rates.

The two are negatively correlated in general, though it is not a perfect relationship.

The default rate and spreads are also highly correlated so the manager must generally be able to anticipate the next change in economic conditions to add value. For example suppose real growth is very low, defaults are high, and OAS for HY bonds is well above average; there is no particular opportunity because the high spread is compensation for high default losses. But if the manager has insight that the economy and growth rate are going to improve, it is an opportune time to move into HY.

The top-down manager would likely vary the portfolio's average credit rating upward to a higher (or downward to a lower) rating in anticipation of weaker (or stronger) than consensus expectations for economic growth. The manager should consider how the portfolio's average quality is calculated. Often, a numeric sequence is assigned to each rating (e.g., AAA = 1, AA+ = 2, AA = 3, AA– = 4). The portfolio's market value weighted average rating is then calculated. This approach can understate exposure to credit risk because default rates and losses tend to increase rapidly as the rating declines. Other more complex "non-arithmetic" scales assign a number that increases much more rapidly than 1, 2, 3, 4 as credit rating declines (e.g., 1, 10, 20, 40 is used by Moody's). Non-arithmetic portfolio averages will show that exposure to credit risk increases at a faster than linear rate, as bond rating declines.

Portfolio average OAS (or other spread) and spread duration are also calculated based on market value weighted average. A higher spread indicates the portfolio has greater exposure to credit risky assets. But spread duration indicates how much the portfolio will change in value if spread changes. Combining the two as duration times spread (DTS) provides a more comprehensive indication of credit risk that either alone.

EXAMPLE: Top-down analysis

An investor with a 1-year holding period is analyzing 4 single rating indexes. Each index uses bonds that all have the same credit rating.

Index Rating (numeric value)	Current OAS, bp	Projected OAS, bp	Projected Credit Loss %, (p x L)	Spread D
A (1)	275	250	0.01	4.5
BBB (2)	325	285	0.04	5.5
BB (3)	475	400	0.12	4.3
B (4)	625	499	0.37	5.8

The numeric value in parentheses after the letter rating is used by the investor to determine arithmetic weighted average portfolio credit value.

1. **Calculate** the expected annual excess return for a portfolio weighted 50/50 in Index BBB and BB.
2. **Calculate** average current OAS, spread duration, and duration times spread (DTS) for the portfolio in Question 1.
3. **Calculate** the average numeric credit rating for the portfolio in Question 1 as well as a portfolio weighted 50/50 in Index A and B.

4. **Discuss** the ways in which comparing the two average portfolio credit ratings in Question 3 to determine the portfolios exposure to credit risk is misleading and **state** three alternate ways to measure the credit risk exposure using the information provided. No calculations are required.

Answers:

1. Average portfolio starting OAS: 0.5(325) + 0.5(475) = 400 bp

   Average portfolio spread change: 0.5(285 − 325) + 0.5(400 − 475) = 58 bp decline

   Average portfolio credit losses: 0.5(4) + 0.5(12) = 8 bp loss

   Average portfolio spread D: 0.5(5.5) + 0.5(4.3) = 4.90

   Expected excess return: 1(400) + 4.9(58) – 8 = 676 bp
2. Average portfolio starting OAS: 0.5(325) + 0.5(475) = 400 bp

   Average portfolio spread D: 0.5(5.5) + 0.5(4.3) = 4.90

   Average portfolio duration times OAS: 4.9 (400) = 1960 bp
3. Portfolio BBB and BB: 0.5(2) + 0.5(3) = 2.5

   Portfolio A and B: 0.5(1) + 0.5(4) = 2.5
4. Credit risk typically increases at a more than linear rate as credit rating quality is lowered. That means portfolio A and B is likely risker than BBB and BB even though the average numbers are the same. Other ways to compare credit risk exposure are to compare:
   - Average OAS.
   - Average spread D.
   - Average D times spread (DTS).

The credit portfolio manager can also use historical spread between credit risky sectors to assess relative attractiveness.

- Suppose a manager examines Figure 25.2, believes the first 5 years of data are distorted by a major financial crisis, the last 5 years are relevant, and spread is mean reverting; that manager would find HY attractive because the spread differential is visually greater than the average of the last 5 years.
- Suppose another manager believes future economic conditions for the next few years will be much worse than consensus expectations; that manager would likely favor IG because the current spread reflects consensus views and economic deterioration should lead to spread widening. Spread widening is a more serious risk in HY than in IG.

Plotting the historical spread for other relationships is also useful. A manager could track the spread difference between 15- and 5-year A-rated bonds to gain perspective on the past relationship and as a starting point for developing a view on how the spread may change. If the manager sees the pick-up in yield for buying 15-year rather than 5-year bonds is average, but the manager forecasts a large increase in 15-year bond issuance, she may expect the spread to increase and overweight the 5-year sector now.

Figure 25.2: OAS for High-Yield Sector

ADJUSTING THE CREDIT PORTFOLIO’S INTEREST RATE RISK

Because top-down management focuses on macro factors such as interest rates, top-down managers are more likely to also actively manage interest rate risk in the credit portfolio. In contrast, bottom-up managers will generally just match interest rate exposure to that of their benchmark in order to focus on security selection issues.

PROFESSOR’S NOTE

Interest rate management techniques are more completely covered elsewhere. This reading coverage is brief and reviews issues such as:

- Increase (or decrease) duration if interest rates are expected to decrease (or increase).
- Adjust key rate duration exposures to profit from expectations regarding nonparallel yield curve shifts.
- Adjust exposure to option features, increasing long (or short) call option positions if volatility is expected to increase (or decrease).
- Increase (or decrease) convexity before large increases (or decreases) in volatility.

It can be difficult to simultaneously manage interest rate and credit risk without derivatives. The available bonds to implement the views may not exist or be unavailable. For example:

- A manager who expects spreads to narrow and rates to increases would have difficulty implementing that view with bonds only. Long corporates would benefit from the spread narrowing but not from the general rate increase. Buying the corporates for increased spread exposure while selling bond futures to lower duration would be a better strategy.
- Adjusting exposure to options by buying or selling callable and putable bonds could be difficult. Buying or selling options on bond contracts is a more straightforward way to directly adjust exposure to option return and risk characteristics.
- Global investors can use currency forwards and bond futures to directly adjust currency and duration exposures, independent of the actual credit risky bonds

selected.

ESG Considerations

Corporate bonds in particular and some other credit risky securities may violate environmental, social, and governance (ESG) portfolio constrains. For example, the bond issuer may be a high carbon emitter and that may be prohibited by ESG portfolio restrictions. Or an asset backed security may include loans originated by predatory lenders (i.e., lenders who are regarded by some as unfairly restricting credit or charging excessively high rates to some groups).

MODULE QUIZ 25.2

To best evaluate your performance, enter your quiz answers online.

1. A credit investor is researching three industries with the goal to directly invest in bonds issued by companies in those industries. The investor is hoping to outperform the benchmark that represents bonds issued from the industries in question. Which of the following credit strategies is *most appropriate* for this investor?
   A. The top-down approach.
   B. The bottom-up approach.
   C. The middle-out approach.
2. A portfolio is using a top-down approach to compute portfolio expected excess return. The index rating category under evaluation is rated BBB. The current option-adjusted spread (OAS) is equal to 330bps and the expected OAS in one year is 180bps. Also, the expected credit loss rate is 0.05% and the spread duration is 5.5. Given this information, what is the top-down excess return for the BBB index if the investor has a one-year holding period?
   A. 5.10%.
   B. 8.25%.
   C. 11.5%.

MODULE 25.3: LIQUIDITY, TAIL, AND INTERNATIONAL RISKS

LOS 25.e: Discuss liquidity risk in credit markets and how liquidity risk can be managed in a credit portfolio.

Video covering this content is available online.

CFA® Program Curriculum, Volume 4, page 268

As we have already discussed, the credit markets are relatively illiquid compared to developed market government bonds, and liquidity in general has declined post 2008-2009 financial crisis.

- Average daily trading volume is down substantially.
- Credit spread is sensitive to flows of funds in the credit markets. For example, large flows out of HY (selling) and into IG (buying) would likely depress HY prices (increasing their yield) while bidding up IG prices (decreasing their yield). In other words, the spread of HY to IG will increase and HY relative performance will suffer. This problem is most likely to occur during periods of financial stress

and have a larger impact on HY than on IG because the HY market is smaller and less liquid.

- The difference in bid-ask is often used as an indicator of liquidity but has become less reliable. Capital and risk considerations have reduced the size of the bond inventory dealers are able to support. Traditionally, dealers would buy and hold bonds for future sale, providing market liquidity.
- One favorable trend for liquidity has been a broader distribution of both IG and HY bonds. The percentage of each market held by the 10 largest funds has declined. Economic theory holds that a market with a greater number and dispersion of participants holding independent views will be more resilient and more liquid.

Credit portfolio managers have had to give more attention to managing liquidity risk. They can:

- Hold a larger percentage of the portfolio in cash.
- Hold a larger percentage of the portfolio in more liquid securities, even if they are outside the normal objectives (e.g., an IG manager who over weights more liquid Treasury securities or a HY manager who holds more liquid IG securities), even if this involves a lower expected return.
- Use liquid derivative instruments as an alternative to the underlying credit risky securities. For example there are regularly traded (though OTC) credit default swaps (CDSs). CDSs provide credit protection to the buyer. The seller of the protection receives funds and pays if a defined adverse credit event occurs. In other words, the CDS protection seller is taking on the credit risk that would have been incurred by buying credit risky securities. (These swaps trade under and may be referred to by various names such as CDX and iTraxx.)
- Use IG or HY ETFs as a temporary investment to gain market exposure and diversification until the desired underlying securities are available.

MANAGING TAIL RISK

LOS 25.f: Describe how to assess and manage tail risk in credit portfolios.

CFA® Program Curriculum, Volume 4, page 273

Tail risk refers to the fact that returns in many security markets experience more large declines than consistent with their standard deviation. These extreme large declines and sequences of consecutive large declines have been observed in credit portfolios as well. These types of events are difficult to model or anticipate. Managers can and should try to quantify the potential losses with the following:

- **Scenario analysis** makes assumptions to describe plausible but unusual conditions and then projects how the portfolio will behave.
- **Historical scenarios** assume conditions that have occurred in the past such as the 2008-2009 financial crisis or telecommunications industry problems in the early 2000s.

- **Hypothetical scenarios** make up possible combinations of extreme events that have not occurred before.

During severe adverse market conditions, correlations tend to move upward, diversification benefits decline, and downside risk is greater than expected. In such conditions, liquidity declines or virtually disappears; therefore, tail and liquidity risk become linked.

Managing tail risk is difficult:

- The manager should try to quantify the risk and hold adequate top quality securities that will retain liquidity during a crisis.
- Diversify the portfolio and specifically identify likely tail risks and hold securities that are likely to benefit if the risk occurs. The problem is, all risks cannot be identified ahead of time or be diversified.
- Use tail risk hedges to protect against extreme events. For example, suppose a manager is concerned about risk in a particular bond market sector and it is as impractical to avoid the sector. The manager could buy CDSs or credit spread options on that sector. The manager makes a one time or periodic payment and receives a defined payment if a defined adverse credit event occurs. The problem is, a cost is incurred at purchase and the more the marketplace believes the risk is likely to occur, the more expensive the protection. For managers who cannot use such credit derivatives, tail risk may be unavoidable.

INTERNATIONAL CREDIT RISKS

LOS 25.g: Discuss considerations in constructing and managing portfolios across international credit markets.

CFA® Program Curriculum, Volume 4, page 275

Investing in multiple markets and currencies offers opportunity and risks. But even investors who restrict holdings to one country should realize the bond issuers in that country may generate significant revenue and profit in other countries, exposing the investor to global risks.

International investing offers greater relative value opportunities. For instance, new issuance of corporate bonds in one country may exceed desired demand, lowering prices of corporates relative to corporates in other countries. Or subtle quality differences may exist. HY bonds in country Z may have a higher percentage of the most speculative bonds compared to HY bonds in country Y. If credit risk is expected to decline the more speculative HY of country Z are likely to outperform, all else the same.

The size of the emerging market (EM) bond sector has been increasing and is now similar in size to the U.S. high-yield (HY) sector. Although both are high yield and high risk, there are differences. In the EM sector:

- Commodity and banking related businesses make up a much greater percentage of the bonds outstanding. That concentration is greater than it appears as much of EM banking is linked to those same commodity businesses.

- Direct government ownership or stakes in companies is high. This gives an explicit or implicit expectation of support if there are credit problems. The risk is the local governments may favor domestic over international creditors if there are problems with the bonds. Even the legal rights of the EM's foreign investors may be less clear.
- The rating on EM non-government bonds may in some cases understate true quality as rating agencies typically will not rate an issuer higher that the sovereign credit rating of the issuer's country.

In global bond portfolios:

- Liquidity is a greater concern. The United States is the most liquid market with transparency of trade volume and price (i.e., public reporting). In other markets, there is less or no reporting.
- Currency risk must be considered as a decline in value of the currency in which the bond is denominated reduces return to investors outside that country. This can be a bigger issue when interest rates of the bond are low, making changes in the value of the currency a bigger component of return for the foreign investor. Global managers may hedge the currency risk by selling forward or swapping the foreign currency for domestic currency of the investor.
- Legal risk can be greater with less familiar or less developed legal protections and bankruptcy law.

MODULE 25.4: STRUCTURED INSTRUMENTS

LOS 25.h: Describe the use of structured financial instruments as an alternative to corporate bonds in credit portfolios.

Video covering this content is available online.

CFA® Program Curriculum, Volume 4, page 278

PROFESSOR'S NOTE

These comments are largely focused on the U.S. market where structured finance is the most developed and largest.

Structured finance represents an alternative to corporate bonds in the credit portfolio. They offer some combination of:

1. Higher yield and expected return.
2. Tailored risk exposure through multiple tranches with varying levels of risk ranging from first tranche (often AAA) to mezzanine last tranche, which could be below investment grade and offer higher expected return.
3. Exposure to specific market sectors such as real estate, consumer credit, or bank loans that cannot be directly targeted with corporate bonds.
4. A diversification benefit. Adding structured finance instruments to a credit portfolio may leave returns unaffected but lower portfolio standard deviation.

There are multiple types of structured finance.

Mortgage-backed securities (MBSs) are pools of mortgage-backed loans. They can be government or privately backed with a range of credit quality and expected return. Compared to corporate bonds:

- Government agency backed MBSs can offer similar yields and spread with greater trading volume and liquidity.
- MBSs have tailored exposure to specific segments of the real estate market. Individual MBSs can be backed by residential or commercial property. (Although some regard certain types of REITS as providing similar exposure, REITS tend to act and be more correlated with the stock market.)
- MBSs are a means of adjusting portfolio exposure to interest rate volatility. Most mortgages and the resulting MBSs offer the borrower the right to prepay the loan. This is economically equivalent to the embedded short call option in a callable bond, but the MBS market is larger, more liquid, and often has less default risk. With decreasing (or increasing) interest rates or an expectation of higher (or lower) interest rate volatility this prepay option becomes more (or less) valuable. Adjusting the level of holdings in MBSs is a way to express a view on future interest rate volatility. This embedded call feature is a reduction in the value of the MBS so increase (or decrease) exposure to MBS if interest rate volatility is expected to decrease (or increase).
- MBSs offer a different exposure to credit risk from that of the corporate bond market. For example, CMBS (MBS backed by commercial real estate loans) are not government agency backed and have credit risk. Suppose OAS on CMBS is higher than normal compared to corporate bonds, and an investor believes real estate prices are likely to improve but corporate profits may be under pressure, it should be profitable to shift out of corporates and into CMBS.

Asset-backed securities (ABSs) are backed by non-mortgage (generally consumer) debt. The collateral can be automobile loans or leases, credit card receivables, student or other personal debt, and accounts receivable. ABSs offer a different source of return and portfolio diversification. Selecting specific types of ABSs (e.g., auto versus student loans) allows the manager to express a view on which sector will provide superior or inferior return.

Collateralized debt obligations (CDOs) are backed by various forms of debt obligations. The CDO collateral is normally some form of corporate debt and CDOs are normally structured in tranches. The most senior tranche is paid first proceeding down to the most junior subordinate tranche which is paid last. Credit quality descends and expected return increases as you move down the tranches. There is little diversification compared to corporate bonds, but the potential benefits include:

- Opportunities to identify relative value. For example, the manager may believe CDOs are cheap or expensive versus corporate bonds, higher or lower quality tranches are misvalued versus each other, or specific types of CDOs such as collateralized loan obligations (CLOs) versus CDOs are misvalued. CLOs are a type of CDO backed by leveraged loans (i.e., use leverage to buy more loans). CLOs generally have high credit quality due to over collateralization and the high quality of the loans held as assets; yet at times they have traded at very high yield.

- Opportunities to express a view on correlation within the underlying collateral. For example, if one manager believes there is +1 correlation between the collateral items then all collateral will default and no tranche can be paid or none will default and all will be paid. That manager should buy the lowest tier tranches to earn the higher expected return as the higher tier tranches are just as likely to default and not be paid. (For simplicity in discussion, collateral default is assumed to involve no recovery and 100% loss on default.) In contrast, a manager who assumes –1 correlation of defaults would buy the highest tier tranche because some collateral will pay and the top tranche will be paid, but some collateral will default and the bottom tranche will not be paid.
- Leveraged exposure to credit risk. The bottom tier tranches of a CDO are akin to a highly leveraged investment in the collateral. If everything works, the return will be high, but if there are losses in the collateral, they may have no value. These tranches may be called the *mezzanine* or *equity tranche*.

Covered bonds are bonds that are typically issued by a financial entity such as a bank. They are a form of collateralized debt (backed by specifically identified assets of the issuer) and also general obligations of the issuer. Because of this dual backing, they are considered a lower risk investment than the general bonds of the issuer.

MODULE QUIZ 25.3, 25.4

To best evaluate your performance, enter your quiz answers online.

1. A credit portfolio manager wishes to better manage liquidity risk in his clients' portfolios. What is an effective strategy for managing liquidity risk?
   A. Use derivative instruments, such as credit default swaps, as an alternative to underlying credit risky securities.
   B. Hold a larger percentage of the portfolio in lower-quality, higher-yield securities.
   C. Reduce holdings in cash-equivalent securities.
2. Shane Miller is an investment analyst who is aware of the importance of managing tail risk during periods of market turmoil. Appropriately managing tail risk includes all of the following actions except:
   A. holding an adequate amount of liquid securities.
   B. holding high-quality securities that produce returns that follow a normal distribution.
   C. implementing a tail risk hedge, which seeks to provide protection against extreme events.
3. Constructing and managing a global bond portfolio has more considerations than managing a portfolio that restricts bond holdings to one country. Which of the following statements accurately represents one of these considerations?
   A. Liquidity is a greater concern in the U.S. market due to the greater volume of issuance.
   B. Legal risk can be a greater concern in international credit markets with less familiar or less developed legal protections and bankruptcy law.
   C. Currency risk must be considered given that a decline in value of the currency in which the bonds are denominated will increase the return to investors outside that country.

4. Mortgage-backed securities (MBSs) are structured financial instruments that can be used as alternatives to investing in corporate bonds. Compared to corporate bonds, MBSs will likely offer:
    A. similar exposure to credit risk.
    B. a means of adjusting portfolio exposure to interest rate volatility.
    C. different yields and spreads with less liquidity.

KEY CONCEPTS

LOS 25.a

Credit risk is narrowly defined as loss caused by a counterparty or debtor's failure to pay. It includes the probability of nonpayment (default risk) and the percentage of loss if there is default (1 − percentage of loss recovery). Credit risk is broadly used to also include:

- Spread risk as the spread bond will underperform in relative price change when spread widens.
  - $\%\Delta \text{ value} = –\text{MD } \Delta y$
  - $\%\Delta \text{ relative value} = –D_S \, \Delta s$
  - $\text{spread} = y_{\text{higher yield}} − y_{\text{government}}$
- Credit migration risk if credit quality is downgraded.
- Liquidity risk as lower credit quality bonds are typically more difficult to trade in a timely manner at close to fair value.

Generally, IG bonds are more affected by interest rate risk because their spread changes are more moderate than interest rate changes. HY bonds are more affected by spread risk because spread changes are the larger. There is also pronounced negative correlation between spread and risk-free interest rate changes for HY. These are generalizations and not inevitable in every situation.

LOS 25.b

Benchmark spread is the difference in YTM of a spread instrument and a comparable duration on-the-run government bond yield: (spread = $y_{\text{higher yield}} − y_{\text{government}}$). G-spread is the same but uses the interpolated duration matched government yield. I-spread is the same but uses swap fixed rates as the benchmark. All three are nominal spreads because they are based on differences in YTM.

Z-spread is the incremental amount that if added to the government bond spot rate curve would discount the bond's future cash flows to its price.

OAS is computed in a manner similar to Z-spread but uses an assumed volatility of interest rates to generate multiple future paths of interest rates and the bond's future cash flows. It is required when there are embedded option features in the bond and represents an "expected average" increment of return to the benchmark rates.

Excess return or expected excess return can be modeled as: XR or EXR = $(s \times t) − (\Delta s \times SD) − (t \times p \times L)$.

LOS 25.c

Bottom-up focuses on identifying individual security misvaluation. The advantage is individual securities are more likely to be inefficiently priced. One way to implement bottom-up is:

- Identify the benchmark universe of bonds to consider and the relevant sector divisions of bonds to analyze.
- Use historical data and projections to determine expected excess return by bond.
- Consider any other relevant differences between the bonds and then decide which to over- or underweight.

LOS 25.d

Top-down focuses on macroeconomic factors that affect credit and interest rate risks. Such managers often look at historical patterns in credit risk changes and spreads. They are more likely to actively manage both interest and credit risk. (Bottom-up managers often just match the interest rate risk of their benchmark.)

LOS 25.e

Liquidity risk has become more of a problem following the 2008–2009 financial crises. Managing liquidity risk includes:

- Holding larger positions in cash and highest quality government securities.
- Using liquid derivatives as an alternative to less liquid underlying assets.
- Using ETFs for temporary changes in desired portfolio exposures.

LOS 25.f

Tail risk refers to the fact that extreme adverse market events are more common than consistent with a normal distribution of return. Scenario analyses can be used to quantify potential losses. Managing tail risk is difficult because these are unusual events but management includes:

- Quantifying the risk and holding sufficient highly liquid securities.
- Diversifying the portfolio and more particularly trying to identify securities that will do well under specific tail risk conditions.
- Using tail risk hedges for specific tail risks.

LOS 25.g

International credit markets offer additional opportunities to identify mispriced securities and diversify risk. The emerging market bond sector has been increasing in size. In quality it is compared to the U.S. high-yield sector, but there are differences:

- It has more exposure to the commodity and banking businesses.
- Explicit or implicit government guarantees are common. This is an advantage but the rights of non-domestic investors in bonds issued within the country can be unclear.
- A bond’s rating is generally limited to no higher than that of the rating of the government of the bond issuer’s country.
- Liquidity risk is greater and currency risk must be considered.

LOS 25.h

Structured finance may offer:

- Higher yield and expected return.
- Tailoring of risk exposure with various tranches.
- An efficient way to gain (or avoid) exposure to specific credit sectors such as real estate or auto loans.
- Diversification.

Structured finance includes MBS, ABS, collateralized debt such as CDO and CLO, and covered bonds.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 25.1

1. **C** Investment-grade investors are primarily exposed to interest rate risk, with secondary exposure to credit and spread risk. In contrast, high-yield investors face little interest rate risk, but are much more exposed to credit and spread risk. (LOS 25.a)

2. **C** When a portfolio includes bonds with and without embedded options, market value weighted average OAS is the best measure of credit exposure. If there are no embedded options, market value weighted average or the other spread measures is sufficient. (LOS 25.b)

Module Quiz 25.2

1. **B** The bottom-up approach is most appropriate in this case since the investor is evaluating the value of individual bonds and issuers relative to a benchmark. In contrast, a top-down approach would involve the investor first identifying attractive sectors and then selecting individual bonds from those sectors. (LOS 25.c)

2. **C** Excess return = (0.0330 × 1) − [(0.0180 − 0.0330) × 5.5) − (1 × 0.0005) = 0.033 + 0.0825 − 0.0005 = 11.5% (LOS 25.d)

Module Quiz 25.3, 25.4

1. **A** CDS and other derivatives can be more liquid than the underlying securities. The manager who wants exposure to credit risky securities would sell credit protection to others. The return enhancement will be in premium income received as the seller.

   Holding more lower-quality securities will lower liquidity as liquidity declines with lower credit quality. Cash equivalents are generally highly liquid. (Module 25.3, LOS 25.e)

2. **B** Tail risks are extreme negative events that may occur more often than is consistent with a normal distribution. The problem with the statement is that you cannot assume the normal distribution applies. (Module 25.3, LOS 25.f)

3. **B** Legal risk can be greater with less familiar or less developed legal protections and bankruptcy law. Liquidity is a concern in global bond portfolios, but the United States has the most liquid market. Currency risk must be considered as a decline in value of the currency in which the bond is denominated reduces return to investors outside that country. (Module 25.3, LOS 25.g)

4. **B** MBSs are generally more liquid than the corporate bond market and include embedded prepayment options. Therefore, varying the allocation to MBSs will

adjust the portfolio’s convexity. MBS provide an exposure to different sources of credit risk and are usually more, not less, liquid. (Module 25.4, LOS 25.h)

TOPIC ASSESSMENT: FIXED-INCOME PORTFOLIO MANAGEMENT

Use the following information for Questions 1 through 6.

John Wortek and Jack Benson are advisors with Pheifer Advisors, located in New York. Pheifer provides investment advice to wealthy investors and institutional investors and has been doing so for more than 10 years. Pheifer has a full staff of analysts, traders, portfolio managers, and economists.

The firm’s chief economist is Paul Worthington. Based on his analysis of supply and demand as well as macroeconomic factors, he expects the U.S. economy to strengthen, corporate profits and stock prices to increase, and an extended period of increasing interest rates. He also forecasts that shorter-term rates will increase more than longerterm rates.

After considering Worthington’s views, Wortek and Benson discuss possible yield curve strategies.

Statement 1: Wortek says that a buy-and-hold strategy for bonds cannot add value versus the benchmark. We need to adopt an active approach to yield curve positioning. We could allocate our weights to key rate durations differently from the weights of our benchmark.

Statement 2: Benson recommends a barbell strategy to outperform a laddered strategy. As long as we keep total portfolio duration the same, the barbell will outperform the laddered in both large upward and large downward parallel shifts that occur over a short period.

Statement 3: They both agree that the barbell should outperform a bullet in their expected flattening yield curve environment.

Wortek and Benson are also planning to meet with Jane Sumner, the portfolio manager of the defined benefit pension plan for Alpha Seed. Alpha has been a publicly traded firm for just three years and is concerned how its pension plan may affect their financial statement reporting. Sumner has asked for some help with managing the plan’s duration gap. Wortek has determined the plan liabilities are $572 million with an effective duration of 12 years. Currently, Alpha’s plan assets of $603 million consist of 60% large-cap U.S. stocks with a beta of 1.1 and 40% bonds with a duration of 4.50.

Sumner has suggested dedicating the fixed income to immunize the plan against interest rate risk. Wortek and Benson gather information on the Treasury bond contract to construct a suitable hedge. The contract is based on 100,000 par. The basis point value (BPV) of the CTD is 125.65 with a duration of 12.42 and a conversion factor of 0.9536. They also suggest Sumner take an active approach with a discretionary over- or underweighting of the full hedge by 10%.

1. Based on Worthington’s forecast, the *most appropriate* strategy would be to:
    A. buy call options on bond contracts.
    B. enter into a pay fixed receive floating swap.

C. buy bond futures contracts on shorter maturity bonds.

2. Based on Worthington's forecast, he will *most likely* predict the best relative performance in long duration bonds will come from:
   A. the high quality U.S. government bond sector.
   B. the AA rated corporate bond sector.
   C. the C rated junk bond sector.

3. Regarding Wortek's and Benson's first two statements concerning yield curve strategies:
   A. only statement 1 is correct.
   B. only statement 2 is correct.
   C. both statement 1 and 2 are correct.

4. Regarding Wortek's and Benson's third statement that the barbell will should outperform a bullet in a flattening yield curve environment; the barbell's outperformance of the bullet will *most likely* be increased if:
   A. there is also a general downward shift in the curve.
   B. there is also a general upward shift in the curve.
   C. the amount of decline in long rates exceeds the amount of increase in short rates.

5. The BPV duration gap for Alpha Seed's pension plan is *closest* to:
   A. 415,050.
   B. 577,860.
   C. 637,528.

6. Assuming that new information has determined that the BPV duration gap is actually 600,000, Sumner applies the 10% discretionary band to the hedge, and interest rates are expected to increase. The number of futures contracts to buy is *closest* to:
   A. 4,100.
   B. 4,550.
   C. 5,000.

TOPIC ASSESSMENT ANSWERS: FIXED-INCOME PORTFOLIO MANAGEMENT

1. **B** The expectation is for interest rates to increase. A pay fixed receive floating swap will benefit as the floating rate inflows increase. With rates increasing, bond prices will decline as will bond futures contracts and calls on the contract. The maturity of the bonds on which the contract is based will affect the rate of decline, but not the direction of movement. (Study Session 12, Module 24.6, LOS 24.e)

2. **C** The expected general increase in rates will lead to a general decline in bond prices. In this case, all the bonds are long duration, but they differ significantly in credit quality. The other key issue in Worthington's forecast is economic improvement that is associated with a decline in credit risk spreads. This will not affect Treasuries, but it will reduce the increase in interest rates on AA and C rated bonds. The offset is most pronounced for the lower-quality, C rated bonds. They have even been observed to increase in price when the general level of interest rates increases, due to significant narrowing of spread. (Study Session 12, Module 25.1, LOS 25.a)

3. **B** Wortek is wrong. Buy and hold can be an active yield curve strategy if the buy-and-hold allocation across the yield curve consciously differs from the allocation of the benchmark across the yield curve. Benson is correct because the barbell will have more convexity and convexity increases upside and decreases downside price change for large changes in interest rates. (Study Session 12, Modules 24.1 and 24.2, LOS 24.a)

4. **C** The barbell is expected to outperform the bullet in a flattening curve because of the differences in how the duration is achieved. The barbell will be exposed to higher duration bonds. The decline in longer-term rates applied to their higher duration will produce larger price gains. The barbell is also exposed to lower duration bonds. The increase in shorter-term rates applied to their lower duration will produce only smaller price losses. The same reasoning is also why a larger decline in longer-term rates and a smaller increase in shorter-term rates will further improve the performance of the barbell.

   The portfolios are duration matched, so a general upward or downward shift in rates has little effect on relative performance. There is a convexity effect, but that is relatively small and generally only apparent for large movement in rates. (Study Session 12, Module 24.2, LOS 24.a)

5. **B** The absolute duration gap in the pension plan is the difference between the basis point values (BPV) of liabilities and assets.

   BPVL = 572,000,000 × 12 × 0.0001 = 686,400

   BPVA = 603,000,000 × 0.4 × 4.5 × 0.0001 = 108,540

   duration gap = 686,400 – 108,540 = 577,860

(Study Session 12, Module 24.5, LOS 24.d)

6. **A** BPV of the Treasury futures contract:

   CTDBPV / conversion factor = 125.65 / 0.9536 = 131.7638.

   100% hedge requires buying contracts to increase the BPVA:

   duration gap / futuresBPV = 600,000 / 131.7638 = 4,554

   Interest rates are projected to increase; using a smaller 90% hedge will leave the BPVA lower and reduce the decile in the asset value, improving performance.

   0.90 × 4,554 = 4,099

   (Study Session 12, Module 24.5, LOS 24.d)

FORMULAS

market volatility: $\sigma_t^2 = \beta\sigma_{t-1}^2 + (1-\beta)\varepsilon_t^2$

factor model based market return: $R_i = \alpha_i + \beta_{i,1}F_1 + \beta_{i,2}F_2 + \varepsilon_i$

factor model based market variance:

$$\sigma_i^2 = \beta_{i,1}^2\sigma_{F_1}^2 + \beta_{i,2}^2\sigma_{F_2}^2 + 2\beta_{i,1}\beta_{i,2}\mathrm{Cov}(F_1, F_2) + \sigma_{\varepsilon,i}^2$$

covariance of returns between two markets, C and D:

$$\mathrm{Cov}(C, D) = \beta_{C,1}\beta_{D,1}\sigma_{F_1}^2 + \beta_{C,2}\beta_{D,2}\sigma_{F_2}^2 + (\beta_{C,1}\beta_{D,2} + \beta_{C,2}\beta_{D,1})\mathrm{Cov}(F_1, F_2)$$

variance of a market, C:

$$\sigma_C^2 = \beta_{C,1}^2\sigma_{F_1}^2 + \beta_{C,2}^2\sigma_{F_2}^2 + 2\beta_{C,1}\beta_{C,2}\mathrm{Cov}(F_1, F_2) + \sigma_{\varepsilon,C}^2$$

price of a stock at time 0: $P_0 = \dfrac{Div_1}{\hat{R}_i - g} \Rightarrow \hat{R}_i = \dfrac{Div_1}{P_0} + g$

Grinold-Kroner expected return on equity: $\hat{R}_i = \dfrac{Div_1}{P_0} + i + g - \Delta S + \Delta\left(\dfrac{P}{E}\right)$

expected bond return:

$\hat{R}_B$ = real risk-free rate + inflation risk premium + default risk premium + illiquidity risk premium + maturity risk premium + tax premium

ICAPM: $\hat{R}_i = R_F + \beta_i\left(\hat{R}_M - R_F\right)$

beta for stock i: $\beta_i = \dfrac{\mathrm{Cov}(i, m)}{\sigma_M^2} = \dfrac{\rho_{i,M}\sigma_i\sigma_M}{\sigma_M^2} = \dfrac{\rho_{i,M}\sigma_i}{\sigma_M}$

correlation of stock i with the market:

$$\rho_{i,M} = \frac{\mathrm{Cov}(i, m)}{\sigma_i\sigma_M} \Rightarrow \mathrm{Cov}(i, m) = \rho_{i,M}\sigma_i\sigma_M$$

equity risk premium for market i: $ERP_i = \rho_{i,M}\sigma_i\left(\dfrac{ERP_M}{\sigma_M}\right)$

where:

ρ_i = 1.0 for a fully segmented market

target interest rate to achieve neutral rate:

$$r_{target} = r_{neutral} + \left[0.5\left(GDP_{expected} - GDP_{trend}\right) + 0.5\left(i_{expected} - i_{target}\right)\right]$$

Cobb-Douglas function (% change): $\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \alpha \frac{\Delta K}{K} + (1 - \alpha)\frac{\Delta L}{L}$

Solow residual = %ΔTFP = %ΔY – α(%ΔK) – (1 – α)(%ΔL)

H-model: $V_0 = \frac{D_0}{r - g_L}\left[(1 + g_L) + \frac{N}{2}(g_s - g_L)\right]$

constant growth model: $V_0 = \frac{D_1}{r - g}$

Fed model: $\frac{\text{S\&P earnings yield}}{\text{Treasury yield}}$

Yardeni model: $\frac{E_1}{P_0} = Y_B - d(\text{LTEG})$ $V_0 = \frac{E_1}{Y_B - d(\text{LTEG})}$

CAPE or P/10-year MA(E) = $\frac{\text{current level of the S\&P}}{\text{average S\&P earnings over last ten years (adjusted for inflation)}}$

$$\text{Tobin's q} = \frac{\text{asset market value}}{\text{asset replacement cost}} = \frac{\text{market value of debt + equity}}{\text{asset replacement cost}}$$

$$\text{equity q} = \frac{\text{market value of equity}}{\text{replacement value of net worth}} = \frac{\text{\# outstanding shares} \times \text{price per share}}{\text{replacement value of assets} - \text{liabilities}}$$

Sharpe Ratio (S): $S = \frac{\hat{R}_P - R_f}{\sigma_P}$

Roy's Safety-First Measure (RSF): $RSF = \frac{\hat{R}_P - R_{MAR}}{\sigma_P}$

Utility maximization: $U_m = E(R_m) - 0.005 \times \lambda \times Var_m$

Marginal contribution to total risk: $MCTR_i$ = (beta of asset $class_i$ with respect to the portfolio)(total portfolio risk as measured by standard deviation)

Absolute contribution to total risk: $ACTR_i = (weight_i)(MCTR_i)$

% of risk contributed by $position_i = ACTR_i$ / total portfolio risk

$R_{s,m}$ = surplus return = (change in asset value – change in liability value) / initial asset value

$U_m = E(R_{s,m}) - 0.005 \times \lambda \times Var_{s,m}$

where:

$E(R_{s,m})$ = expected surplus return

$Var_{s,m}$ = variance of surplus return

After-tax *standard deviation* = pretax standard deviation (1 – t)

After-tax *deviation from midpoint of target asset allocation* = pretax deviation / (1 – t)

Foreign Asset Return and Risk:

$R_{DC} = (1 + R_{FC})(1 + R_{FX}) – 1 = R_{FC} + R_{FX} + (R_{FC})(R_{FX})$

RDC ≈ RFC + RFX

$$R_{DC} = \sum_{i=1}^{n} w_i (R_{DC,i})$$

$\sigma^2(R_{DC}) \approx \sigma^2(R_{FC}) + \sigma^2(R_{FX}) + 2\sigma(R_{FC})\sigma(R_{FX})\rho(R_{FC},R_{FX})$

$\sigma(R_{DC}) = \sigma(R_{FX})(1 + R_{FC})$

where:

R_{FC} = the return on a foreign currency denominated risk-free asset

Yield income: Annual coupon amount / current bond price

Rolldown return: (projected ending bond price (BP) – beginning BP) / beginning BP; based on no change in the yield curve

Price change due to investor yield change predictions: $(–MD \times \Delta Y) + (½C \times \Delta Y^2)$

Less credit losses: predicted default adjusted for recover rate

Currency G/L: projected change in value of foreign currencies weighted for exposure to the currency

Rolling Yield = Yield Income + Rolldown Return

r_p = portfolio return (amount) / portfolio equity

Return for a leveraged portfolio: $r_I + [(V_B / V_E) \times (r_I – r_B)]$

where:

r_p = return on portfolio

r_I = return on invested assets

r_B = rate paid on borrowings

V_B = amount of leverage

V_E = amount of equity invested

leverage = (notional value of contract – margin amount) / margin amount

Rebate rate = collateral earnings rate – security lending rate

$$\text{convexity} = \frac{\text{Macaulay duration}^2 + \text{Macaulay duration} + \text{dispersion}}{(1 + \text{periodic IRR})^2}$$

BPV = MD × V × 0.0001 = Price Value of a Basis Point

$$\text{futures BPV} \approx \frac{\text{BPV}_{\text{CTD}}}{\text{CF}_{\text{CTD}}}$$

$$\text{N}_\text{f} = \frac{\text{BPV of liability} - \text{BPV of current portfolio}}{\text{BPV of futures}}$$

$$\text{effective D} = \frac{\text{PV}_{-} - \text{PV}_{+}}{2 \times \Delta\text{curve} \times \text{PV}_0}$$

In formulas that refer to MD, and if effective duration differs from MD, option positions are present and effective duration must be used instead of MD.

The notional swap principal (NP) required to close the duration gap for a 100% hedge is the duration gap in BPV divided by the swap BPV per 1 NP.

%Δ value = $-\text{MD}_{\text{key rate n}}\ \Delta y_n$

MD = Macaulay duration / (1 + $\text{YTM}_{\text{periodic}}$)

%Δ value = –MD Δy

%Δ relative value = $-\text{D}_\text{S}\ \Delta s$

spread = $y_{\text{higher yield}} - y_{\text{government}}$

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